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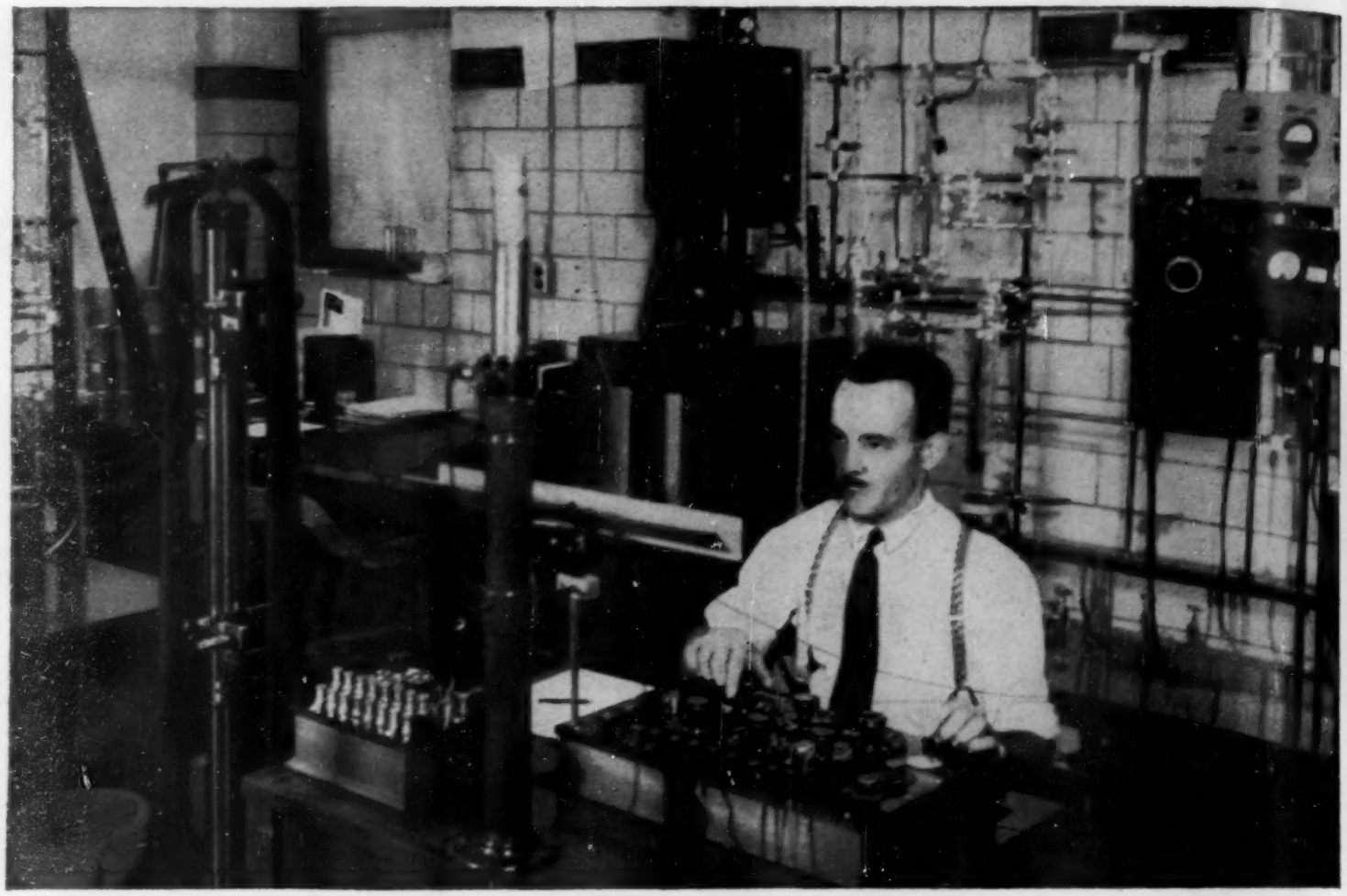
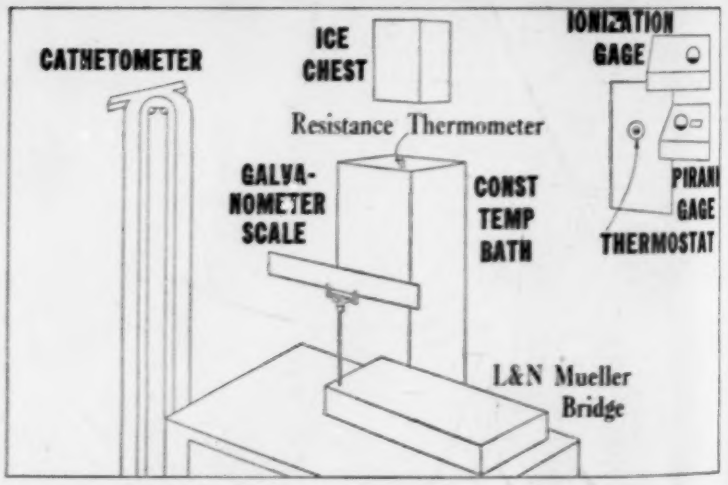
(See page 205)

Mueller Bridge for Measuring Temperature During Precise Vapor Pressure Studies



Apparatus for precise measurement of vapor pressures, photographed above and diagrammed at right, shows use of manometer, cathetometer, and G-2 Mueller Bridge at Bureau of Mines, Bartlesville, Okla. Manometer and sample container are immersed in the constant temperature bath. Before the compound to be studied is introduced into the container, the system is evacuated, using the Pirani gage to indicate pressure down to one micron and the ionization gage for lower pressures.

During measurements, the cathetometer is used to read the vapor pressure as indicated by the mercury manometer. The thermostat automatically regulates the bath temperature, and the Mueller Bridge precisely indicates temperature of the sample.



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The Climate of the Arctic as Viewed by the Explorer and the Meteorologist

William Herbert Hobbs

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THE CLIMATES OF ARCTIC REGIONS as seen by the explorer-geographer and by the professional meteorologist are in sharpest contrast. This is explained by their different methods of observation. The explorer has been obliged to learn the hard way, by making his observations upon the ground with comparatively small use of instruments for precise measurements; the meteorologist, by extrapolating the weather at any place from a few *fixed* weather stations, where the meteorological units are all measured with the greatest precision, at frequent intervals and over long periods of time.

Extrapolation is based on a fundamental assumption that the weather of any region is brought to it from outside by cyclonic low-pressure areas which migrate across it. The tracing of the paths of the cyclones and the construction of synoptic weather charts which set forth the meteorological units is all a work of extrapolation. Actual observations made between the stations do not come within the scope of the inquiry.

A president of the American Meteorological Society has said: "A forecast is made in accordance with past trends, as evidenced by previous maps and the pressure tendency field. . . . This is largely a subjective process. . . ." (*11*).

Where there are closely meshed weather stations, the inadequacy of this standard technique of the meteorologist may not be generally apparent; but in remote undeveloped regions, where weather stations can be set up only with the greatest difficulty and at very great distances from each other, its deficiencies are sufficiently obvious. Extrapolation across hundreds of miles, and based on theories derived in other regions, must lie within the realm of the imagination. To apply extrapolation at all in such regions, it is necessary to *assume* that low-pressure areas invade and cross over them; and, as we shall see, there are vast areas where the weather is self-contained and without transiting cyclones.

I propose to illustrate the working out of the contrasted explorer's and meteorologist's methods of inquiry within two great Arctic regions. These are: (1) the Central Arctic Basin, a vast expanse of sea which is covered over throughout by floating ice floes, and (2) the glacier-covered, high plateau-island of Greenland. These regions are of the same order of magnitude, each of 1,000,000 square miles or more. The Arctic Basin is nearly circular and about 1,400 geographical miles in diameter. Greenland is of obovate outline about 1,400 miles in length and 600 in average breadth. Except for one brief period, when two meteorological bases were precariously maintained in Central Greenland, weather stations have been set up only on the extreme fringes of these two great Arctic regions.

In the future, as in the past, it will not be possible to maintain fixed weather stations within the Arctic Basin, for the reason that its cover of floating ice is constantly drifting. Since it has been impossible to make fixed stations in the interior of the Arctic Basin, meteorological theories based on a supposed planetary air circulation have taken their place.

The climate of the Central Arctic Basin as seen by the meteorologist. As far back as the middle of the 19th Century two American meteorologists, Matthew Fontaine Maury and William Ferrel, conceived the Arctic Polar Basin to be a low-pressure area with barometric reading at the Pole itself (by extrapolation from far outside) 29.63″ of mercury. To cite Ferrel: "Near the poles the tendency to flow towards the equator seems to be greater and causes a current *from* the poles. . . ." A year later (1857) the English meteorologist, James Thomson, independently expressed much the same idea in his "On the grand currents of atmospheric circulation."

Twenty years later a quite different theory was promulgated. The German physicist, Von Helmholtz, who had given much attention to meteorological theory, conceived the earth's polar regions to be areas of radiation, because of a supposed frigid surface, above which the cooled air must, he reasoned, be mounded up and flow off toward lower latitudes. In 1922 the Norwegian physicist and geophysicist, Vilhelm F. K. Bjerknes, gave to this idea a modern dress by his hypothesis of the "North Polar Front." It assumed, as Von Helmholtz' theory had done, that within the area surrounding the Poles there is a piling up of cold air, and that it is separated by either a surface of discontinuity or by a transitional layer from that outside. From this polar anticyclone, cold air was supposed to be moving out in all directions.

As we are to see, the hypothesis of the North Polar Front, or polar anticyclone, above the Arctic Basin was, at the time of its promulgation, contrary to all that had then been learned concerning its climate, and especially to what Bjerknes' great compatriot, Nansen, had shown a quarter-century earlier. The Bjerknes theory was, however, adopted by the meteorological profession throughout the world and was regularly made use of in constructing climatic charts of the Northern Hemisphere.

The climate of the Central Arctic as learned by the explorer. The first International Polar Year for concerted study of the polar regions (1882–83) saw almost the beginning of Arctic exploration bases, with others set up at intervals into the first decade of the 20th Century. A number of these were on the outer fringe of the Central Arctic Basin. Six of these widely separated stations showed the mean annual atmospheric pressure to indicate neither a polar cyclone nor an anticyclone, but an amazingly uniform normal pressure. In millimeters of mercury these annual pressure means were measured as: 758 at Cape Sheridan in latitude 82½°, 759 at Fort Conger (Greely, 1882–83) in latitude 81½°, 760 at Fort Conger (Peary, 1908–09), 758 at Point Barrow in latitude 71°, 760 at Cape Fligely in latitude 82° (Jackson, 1895–96), and 757 on Rudolf Island in latitude 82° (Nansen, 1895–96).

In the year 1894 the great explorer-scientist, Fridtjof Nansen, had set out on his polar ship *Fram* to drift in the pack across the Arctic Basin, making full scientific investigations throughout. For two and a half years (1894–96) this exploring expedition drifted slowly across the area along a chord about one-third of the way in to the Pole.

Nansen's meteorological observations showed the Arctic Basin to be the greatest area of uniformly normal atmospheric pressure anywhere known on our planet, and today found to be unique. In consequence, it was an almost windless region. For the first year of the *Fram's* drift the mean annual air pressure was registered as 758 mm of mercury, with but slight variation between winter and summer. During the second year the ship drifted throughout along the 85th parallel, only 5 latitude degrees from the Pole, and the mean annual pressure observed along it was 761 mm. For the 7 months of the third year, about equally divided between winter and summer, the corresponding pressure was found to be 758 mm. From these observations the Norwegian meteorologist, H. Mohn, calculated that the range of mean monthly atmospheric pressure at the Pole itself could not have exceeded 5 mm (*32*). Of the windlessness of the region through which he had drifted, Nansen had much to say when he visited the writer in 1929. This was to be the experience of Peary, also, when he crossed the region and achieved the North Pole in 1909.

The Soviet polar studies. Further proofs of the normal atmospheric pressure over the Arctic Basin and its absence of wind were to come in the years 1937 and 1938. In 1937 the Soviet S. S. *Sedov* had been caught in the Arctic pack to the north of Siberia near the 82nd parallel, and the ship had drifted across the basin during the next two years. For the *Sedov's* drift the mean annual atmospheric pressures for these years were 760 and 760 mm.

During these same years the Soviet North Pole Station had been in operation. Laid down by airplanes at the Pole itself, the station drifted slowly southward with the floes along the meridian of Greenwich for the first 5 latitude degrees, then south southwestward about parallel to, and 100–200 miles off, the Greenland east coast. This continued until it had reached the 76th parallel—a total drift of over 1,000 geographical miles.

Until the Arctic Basin had been left behind, the most uniform of meteorological conditions prevailed. The region was so nearly without wind that only rarely could a windmill be operated to charge the batteries. Atmospheric pressure was almost absolutely normal (*20*).

The drift of the S. S. *Sedov* had coincided with that of the North Pole station; so, combining the observations and bringing in those from the permanent Soviet weather stations on the fringe of the basin, Dzrdzeewski was able to construct synoptic pressure charts for the basin as a whole. To cite him: *"The usual hypothesis of a constant polar anticyclone breaks down in the light of the observations of the North Pole Station and Sedov. . . . The point of greatest interest . . . is that the chart to show mean annual air pressure the isobar of 1013 mb*[1] *surrounds the Central Polar basin with no other isobar within it"* (*4*; italics in the original).

As soon as the North Pole Station had drifted within about 200 miles of the Greenland coast, however, the conditions completely changed. It had now entered a region of almost incessant storms. The leader then wrote in his diary: "Greenland is letting us know where it stands." Much later, when near the end of the drift, he added: "The wind has been blowing constantly since we got into Greenland waters. The blizzard has made hermits of us. We stay inside the tent like badgers in their lair" (p. 236). But this has to do with the other Arctic region.

The climate of Greenland as learned by the explorers. The first important invasion of Greenland by an exploring party was that of Baron Adolf Erik Nor-

[1] Normal pressure.

denskiöld in 1883, who made his penetration from near Disko Bay on the west coast in latitude 68° N. Southeast winds of great force were faced for a distance estimated to be 100 km.

Complete transections of the island were first made by the great explorers, Nansen in South Greenland in 1888 and Peary in two double transections of far Northern Greenland in 1892 and 1895, after he had already made deep penetrations from the west coast.

Nansen's transection was made from the east coast, climbing in the face of fierce blizzards to an imperceptible divide at an elevation of 9,000′ and then, with a small sail raised on the sled, coasting down the west side. Of the winds encountered he wrote (*19*):

> The prevailing winds were therefore land winds which blew from the interior toward both coasts. This points to a maximum air pressure in the interior and to air currents toward it which flow off on both sides over the slope toward the sea.

This was the initial discovery of the glacial anticyclone of Greenland, which was, as we shall see, to be confirmed throughout the next half-century by all the great Greenland explorers, two of them, Alfred De Quervain and Alfred Wegener, meteorologists.

Peary's summary statement on the climate of Greenland. Next after Nansen to describe the climate of Greenland was Robert E. Peary, greatest of polar explorers. After more than 3,000 miles of sledge travel over Greenland, Peary summed up the pattern of its wind system in the following sentences (*21*):

> . . . the direction of the wind of the "Great Ice" of Greenland is invariably radial from the center outward, normal to the nearest part of the coastland ribbon. So steady is this wind, and so closely does it adhere to this normal course, that I can liken it only to the flow of a sheet of water descending the slopes from the central interior to the coast. The direction of the nearest land is always easily determinable in this way. The neighborhood of great fjords is always indicated by a change in the wind's direction; and the crossing of a divide, by an area of calm or variable winds, followed by wind in the opposite direction, independent of any indications of the barometer.

This wind-pattern above the inland ice of Greenland, which has the model of a gigantic cake of very thin batter, can be summed up by the single word *katabatic,* down-slope, except as the winds are deviated clockwise by as much as half a right angle, due to the earth's axial rotation.

Like other explorers, Peary had observed the winds of Greenland where they are, and not from permanent stations in fixed positions outside. For this reason they have not been taken into account by professional meteorologists. Moreover, the direction and force of the wind was as a rule, not measured on precision instruments with data which can be expressed in numerical figures.

The direction of the wind and its force were learned by him because he had had to face it while the sled-dogs toiled strenuously, not against a preceptible slope, but only against the wind; or, *per contra,* with sail raised for a tail wind, all his efforts given over to applying a brake to prevent the sled from overrunning the dogs. Wind force was registered also in the daily runs as plotted on the chart of the course. Those on the downslope had been two to three times as long as those on the ascent. In camp the tent always had to be set up with the opening on the lee side, or it would have been blown away.

While in camp, wind force and direction had been noted by the bellying-in of tent walls, which pressed against the bodies of the men in their cramped quarters. Everywhere except within a cold interior area, the dominant wind direction is graven on the hard-packed snow in the furrows of its surface—the *sastrugi.* These are so constant in direction as to be used in laying the course.

Over the inland ice the wind direction and its force are also indicated by the motion of fine snow, which is continually drifting outward over its surface toward all coasts. To cite Peary again (*21,* p. 234):

> There is one thing of special interest to the glacialist—the transportation of snow on the ice-cap by the wind. No one who has not been there can have any conception of its magnitude. The wind is always blowing, and blowing always on lines which would be gravity lines from the interior. . . . I have walked for days in an incessant sibilant drift of flying snow, rising to the height of the knees, sometimes to the height of the head. If the wind becomes a gale, the air will be thick with the blinding drift to the height of 100 feet or more. . . . When it is remembered that this flow of the atmosphere from the cold heights of the interior ice-cap to the lower land of the coast is going on throughout the year with greater or less intensity, . . . it will be seen that the above assumption is not excessive.

Observations made by the Greenland exploring expedition of 1906–08. After Peary's North Greenland explorations, European expeditions, mainly from Denmark, followed during the early years of the 20th Century. The first of these was a Danish one to northeast Greenland in the years 1906–08, led by Mylius Erichsen. On his staff were three meteorologists: Alfred Wegener, W. Brand, and the then student, Peter Freuchen. Two meteorological stations were set up, one of them on the coast in latitude 77° N., where Wegener and Brand were located. Wegener at the base station had kite and captive-balloon equipment. With this he was able to establish the fact that

the ground observations made in a station on the coast (where it was shielded by rock cliffs) gave no true picture of the local winds (*26*). These were by the aerological aids first encountered at an elevation of 1,000 m, the height of the rock walls. All strong winds were found to blow from the northwest, the down-slope direction of the inland-ice, with the 45° clockwise deviation. Up to that time the prevailing easterly winds everywhere encountered off the northwest Greenland coast had been supposed to have come across the island from the East Greenland Sea. These observations of Wegener, the first ever to be made in northeast Greenland, thus were the first from a meteorologist to confirm Peary's law of outblowing winds.

Wegener's observations were also significant in showing that meteorological ground observations made in a fjord bottom near the coast do not give reliable results with regard to the local winds. Hinrich Rink, long a keen observer while an inspector in West Greenland, had learned this as a result of his long residence there. On many occasions the overriding of the bottom currents by strong outward-blowing winds would be made known by the roaring of the blizzard overhead, which sometimes continued for days, but with no ripple to be seen on the water of the fjord below (*24*). At other times the wind would get down into the fjord, but with a quite different direction, since it always blew parallel to the local fjord walls.[2] The air pressure is the only meteorological ground unit which can be reliably observed at a fjord-bottom station.

Dating from this, his first of several Greenland expeditions, Alfred Wegener became a strong supporter of the Greenland anticyclone and continued to be to his tragic death on the ice cap in 1930.

Glacial anticyclones over both Greenland and the Antarctic. The only existing continental glaciers are those over Greenland and the Antarctic continent. The latter is of about the area of the entire United States; the former, of that part of it which is east of the Mississippi River. By assembling the wind observations made by all the sledging parties when traveling over the inland ice covering these great areas, the writer was in 1910 able to show that both areas were alike under a system of outblowing winds, and he gave to each of them the name *glacial anticyclone* (*8*).

Observations made on the Greenland expeditions of 1912–13. The years 1912 and 1913 were to see no less than four Greenland exploring expeditions, three of them complete transections and one of them a double cross-section. Three were Danish and one Swiss. All were able to confirm the everywhere-prevailing outblowing winds of the glacial anticyclone.

The Swiss expedition of 1912 was led by the distinguished explorer-meteorologist, Alfred De Quervain, who made a transection of the inland ice from Disko Bay on the west coast to Angmagssalik on the east coast, a south-central cross-section. He encountered the same pattern of winds that had been described by Peary, and since he passed through the central area of the island—something that Peary had not done—he found there a cold area sharply set off from that over the inland ice outside. This was shown both by its much lower air temperature and by the three-times-greater daily range of temperature, though the common border was marked by no topographical break in the surface (*2*). This central area is quite naturally assumed to be the interior area of downdraft which feeds the outblowing winds.

The second Danish northeast Greenland expedition was led by Capt. J. P. Koch. Its scientific reports were written jointly by him and his principal companion, Alfred Wegener (*13*). A winter was spent at station Borg, set up for meteorological and other scientific observations on the inland ice of northeast Greenland, and the following summer a great transection of the island was made to the west coast at Pröven (latitude 72½° N). The pattern of the winds encountered illustrated the glacial anticyclone in great perfection, and they confirmed the central downdraft area, as Dr. De Quervain had already done.

Knud Rasmussen, who with Peter Freuchen made a double crossing in north Greenland near, but farther south than, the southernmost of Peary's crossings, confirmed the pattern of outblowing winds (*22*).

Eynar Mikkelsen, in the years 1909–12, directed a Danish expedition in search of the remains of the lost Erichsen party and to find, if possible, their maps and diaries. He made an interior sledge journey from Danmarkshavn over the ice cap in a north-northwesterly direction to Independence Fjord. The winds encountered throughout were all from the westerly quarter down the slope of the inland ice (*16*).

Rasmussen's Second Thule Expedition of 1916–18, this time across the inland ice of northwest Greenland (*23*), and Lauge Koch's quite remarkable sledge journeys of 1920–23 on and about northeast Greenland (*14*), also revealed the same down-slope winds everywhere.

In 1926 this writer brought together all the scattered meteorological data derived from both Greenland and the Antarctic up to that time and issued them under the title, *The glacial anticyclones* (*9*). The Antarctic

[2] This vitally important knowledge the writer acquired the hard way when a Greenland tenderfoot a score of years ago. Alone in a small rowboat on a crooked fjord, the high waves threatened to upset his craft and precipitate him into the icy water. He rowed madly to double a point which was in sight ahead. When around the bend, the situation was still quite unchanged.

data of most significance had been those observed over the inland ice by sledging parties, and these clearly revealed the Antarctic anticyclone. These winds had not, however, been taken account of by the professional meteorologists, who had occupied the coastal weather stations; and, since the theory of polar cyclones was at the time the dominant one, the reaction of the meteorological profession was that, *if* such an anticyclone actually lay above the inland ice, it must be thin and overlaid by a cyclone (*7*).

The University of Michigan Greenland expeditions, 1926–33. It thus became an important inquiry to measure, if possible, the thickness of the layer of outblowing winds and fix the altitude of its ceiling. To pursue this inquiry in Greenland, this writer organized the Greenland expeditions of the University of Michigan and directed the four which were carried out between 1926 and 1931. The fifth was directed by his colleague, Dr. Ralph L. Belknap. During these years four aerological stations were set up close to the glacier front in West Greenland: at Ivigtut in latitude 61° N, at Mount Evans in latitude 67° 30′, at Camp Scott in latitude 73°, and at Peary Lodge in latitude 74° 15′. At each of these stations daily pilot balloons were sent up and their paths followed by theodolite to an average height of 7,000 m, but with many to much higher levels. Each of the four stations was maintained for at least a year, the main station of Mount Evans for two years, and at this station 776 pilot balloon ascents were carried out. By these investigations the ceiling of the outblowing winds was found, near the west border of the inland ice, to be at about 3,000 m, or roughly 2 miles (*33*).

Alfred Wegener's German expedition of 1929–31 to take measurements of the Greenland anticyclone. A preliminary expedition to fix the position of the stations for the main expedition was carried out in the summer of 1929. On this, Dr. Wegener was accompanied by three well-known meteorologists: Johannes Georgi, Fritz Löwe, and Ernst Sorge. All were destined to play important roles on the main expedition. This preliminary expedition made two deep penetrations over the inland ice to distances of 100 and 130 miles, respectively. They were made in the face of strong head winds during the inward journey, but with tail winds on the return (*28*).

The plan of the larger expedition, for the purpose of deriving measurements of the glacial anticyclone, was outlined by Alfred Wegener in an *avant propos* issued in 1928 (*27*). To cite:

> On the wind relationships in greater elevations we have up to the present those only from West Greenland (De Quervain, Hobbs). If one is to understand in toto the kinematics of the glacial anticyclone one must study the distribution of the wind and likewise the temperature distribution along a complete west-east cross-section, and, if possible, as far up as the stratosphere. It is still an open question whether the so astoundingly regular air distribution of the glacial anticyclone extends upward to the border of the stratosphere, or is earlier replaced by winds flowing in above. . . .
>
> . . . The stations must be along a west-east cross-section of Greenland, thus, two in western and eastern coast regions, and one in the central névé region within the realm of the cold core of the anticyclone.

The main "Alfred Wegener Expedition" was carried out as planned, except that Dr. Georgi, who was in charge of the important central station of *Eismitte*, was, even as late as October, not yet supplied with his prefabricated winter house, adequate food or fuel supplies for the winter months, or all of his aerological equipment. At great risk to his life, Wegener set out with a great sledging caravan to take in these needed supplies, but he encountered such fierce head winds that most of the sleds had to be sent back. With Dr. Löwe and one heroic Eskimo, Willem Rasmussen, the leader pushed on with a single sled, but met with such violent surges of the outblowing winds that he was compelled to jettison most of his cargo and arrived at the station with Dr. Löwe's feet so badly frozen that he had to be left there and have his toes amputated. On November 1, his 50th birthday, Wegener and the faithful Rasmussen left *Eismitte* for the coast, but both perished on the way out.

With the extra mouth to feed, Georgi and his staff at *Eismitte* dug a cave snow-house, husbanded to the limit the scanty food and fuel, survived the winter, and performed the planned research—a really great accomplishment.

The cyclones which arrive at Greenland's west coast are switched north. While Wegener's expedition was in occupation of its three "profile" aerological stations, the British Arctic Air-Route Expedition, led by the youthful Gino Watkins, was maintaining for a period of 7 winter months an "Ice Cap station" in the Greenland interior near latitude 68° N. For the full year it maintained also a "base station" on the east coast, near Angmagssalik, in latitude 66° N. Neither station had aerological equipment (*17*). At the same time, also, the University of Michigan Greenland expeditions were maintaining two aerological stations, one at Ivigtut in extreme South Greenland (latitude 61½° N), the other on the west coast in latitude 73° N.

This unique situation, with 7 expedition stations operating, 2 in the interior and 5 carrying out upper-air studies, suggested to this writer that by combining in a post-mortem operation after the reports from the Danish coastal stations without radio had become available, it would be possible to trace the tracks of the cyclones which had arrived at the west coast

during the year, for the *pressures* recorded at the coast stations could be relied upon. The suggestion was made to Dr. Georgi, who had been director of the *Eismitte* station. He gladly consented, the British, German, American, and Danish observation data were brought together, and the inquiry was carried out. This study revealed that those cyclones which had reached the west coast from a westerly quarter had been turned from their courses and diverted north up Davis Strait and Baffin Bay. Cyclones on tracks farther south which had passed Cape Farewell over the Atlantic had moved up the East Greenland Sea (*5*).

A somewhat similar inquiry, and with similar results, was conducted by R. L. Belknap for 1932–33 (Second International Polar Year), another favorable year for such a study (*1*). The Wegener expedition at its West Station also conducted such an inquiry, with the result that no cyclone was found to have made the transit of Greenland (*10*). Of the wind constancy Kurt Wegener says: "Along the route of the expedition from West Station to *Eismitte,* it blows from southeast to east southeast" (*29*).

At West Station, located between the Michigan stations, a closely agreeing value was obtained for the thickness of the layer of outblowing winds. From a locality 1,000 m higher and over the edge of the inland ice the ceiling was found at 4,000 m, to compare with 3,000 m measured at the four Michigan border stations (*29,* p. 31).

The downdraft area of central Greenland. At *Eismitte,* within the downdraft core of the anticyclone, Georgi found the thickness of this bottom layer of "heavy air" to be only 400 m, not 3,000 m, as at the margin of the inland ice in west Greenland. All his attempts to get kites above this ceiling were futile (*30*). Further evidence of the downdraft appears on his daily weather chart for the entire period of occupation (*6*). On this chart air pressure and temperature can generally be seen to vary together, not in reciprocal relation, as is common where air currents move laterally. With increased vigor of downdraft—higher air pressure—the adiabatic elevation of the temperature of the sinking air should increase and be registered in the near-surface layers.

Quite unexpectedly, a remarkable proof of the strong downdraft within the core of the anticyclone was furnished by a flight across Greenland in an effort to find the lost Wegener. The German Flight Captain Wolfgang von Gronau, in April 1931, flew direct from Scoresby Sound on the East Greenland coast in latitude 70° N southwestward to Sukkertoppen on the west coast in latitude 66°. This took him through the core of the anticyclone a little to the south of the *Eismitte* station. His plane, despite all his efforts to prevent it, was forced down by the downdraft, but when near the glacier surface he was able to level off and continue his flight so near to the surface that his radio antenna dragged behind in the surface snow. He had entered the 400-m-thick layer of the "heavy air" which flows outward along the surface (*New York Times,* August 19, 1931, p. 3, col. 8). One of the early plane crossings during World War II was less fortunate and crashed within the core area.

The core or "névé region" of the anticyclone was further proved to be an area of very heavy snow precipitation. Fine dry snow was separated out from the near-surface "heavy air" layer. On 213 days out of 365 (58%) snow was precipitated, and on 191 of these it was observed to be drifting out. At the other interior weather station within the core area, the British "Ice Cap station," snow was precipitated on 57 days of the 181 that it was occupied—some without observations—and on 23 of these it was observed to be drifting (*18*). Such heavy precipitation within the core of the anticyclone explains the origin of the stupendous quantities of snow which have been observed by all sledging parties to be almost constantly drifting outward over the flanks of the inland ice (*21*). Its only source is obviously the ice spicules of the cirrus and other closely related cloud forms, the dominant types observed above *Eismitte.* These would be adiabatically vaporized in the downdraft and be reprecipitated as they approached the glacier surface. At the end of the long winter season much of this snow is found piled up outside. That drifted during the summer months is largely melted within an intramarginal zone, where it produces the superglacial lakes and rivers always found there late in the season.

The observations made at all three profile stations of the Wegener expedition confirmed the presence of the glacial anticyclone. To cite Kurt Wegener's final conclusions (*31*):

> The observations of the wind at the profile stations show that the "heavy wind" already known for a long time is the characteristic wind of the inland ice which everywhere flows off the inland ice (p. 4). This phenomenon Hobbs has called the glacial anticyclone. As type examples of the "glacial anticyclone," which holds good for all seasons of the year, are the South Polar region and Greenland. . . . The statistical data show us that we have to do with a high pressure area at the level of the sea, from which on all sides air is streaming out. . . . The physical explanation of the glacial high pressure area . . . is obviously due to the outgoing heat irradiation of the ice surface (*Boden*). This has for a consequence that far up in the stratosphere the air-masses over Greenland sink down, stream out below, and from high outside a new instreaming develops (*31,* p. 28).

The Greenland climate according to the meteorological profession. The technique of the meteorological profession has stemmed from the assumption that the climate of any region is the result of weather that is brought into it from outside through the medium of migrating cyclones, which move into and over it. We have seen through the observations of explorers made now over half a century that the Greenland system of outblowing winds precludes any such transit of cyclones. Moreover, special studies carried out in 1930–31 by collaboration of three great expeditions showed that cyclones which arrived at the Greenland west coast had been diverted northward along the coast.

The first meteorological stations set up in Greenland date from the First International Polar Year (1882–83), when there were but few stations, and these located on the southern coasts. From them alone many tracks of cyclones were mapped crossing Greenland's thousand and more miles, and these tracks were marked out with the greatest precision (*25*). This is the origin of a myth which has persisted to the present day. Based on a few coastal stations in fjord mouths, from which reports now go out daily by radio, cyclones may be seen crossing Greenland on almost any daily synoptic chart issued by the Canadian Meteorological Office (Hobbs and Belknap, *1*).

But let us consider now two late memoirs by professional meteorologists on the climate of Greenland. The earlier of these to make its appearance dates from World War II, when in addition to coast stations, there was one located on the southeast flank of the inland ice about one-third of the way in to the divide. The author of this memoir is a professional meteorologist of the U. S. Weather Bureau who has now had experience in both the Arctic and the Antarctic (*3*). The following citation is from the abstract at the head of his paper:

> The published results of previous investigations reveal that meteorologists and glaciologists are not in agreement as to the role of the Ice Cap as a cold source in the general circulation, the importance of the Ice Cap as a barrier to air movements in the lower levels, and the principal sources of nourishment for the Ice Cap itself. . . .
>
> . . . This new survey of Ice Cap problems, *based upon a study of synoptic weather charts* and the author's experiences on the Ice Cap, leads to the following conclusions: The important outbreaks of Ice Cap air require a favorable stage in the general circulation and are not due to "strokes" of the glacial anticyclone; the transit of fronts and storms across the Ice Cap is governed by the general atmospheric circulation, fall and early winter being normally more favorable than summer, but crossings are possible at any time of the year; the principal nourishment of the Ice Cap is derived from normal cyclonic and orographic precipitation processes, and only little is obtained from sublimation deposits. (Italics not in the original.)

Dorsey's memoir, which is illustrated by 16 daily synoptic charts of Greenland (isobars only), shows cyclonic low-pressure areas crossing Greenland without modification of their courses either by the coast, by the outblowing winds, or by the rising dome of the two-mile-high glacier in their paths. He offers in the memoir itself not the slightest evidence that cyclones do cross Greenland. This would obviously be impossible, since there were at the time no observations from the interior to supply such evidence. No account had been taken by him of the earlier studies by Georgi (*5*) and Belknap (*1*) (made when interior observing stations were in operation), which indicated that those storms which arrived at the west coast had been switched up Davis Strait and Baffin Bay.

Dorsey's basis for tracing the transit of each cyclone would appear to have been finding a cyclone off the Greenland west coast on a certain date, and another, which was without identifiable thumbmarks, off the east coast enough later to have had an assumed sufficient time to have made the transit.

The other recent monograph on Greenland climate by a meteorologist is entitled, "Climate and weather over the coastland of northeast Greenland and the adjacent sea" (*12*). This title does not correctly describe the memoir, which includes nearly 100 daily synoptic charts of Greenland (isobars only). These are based wholly on observations made at 9 Danish coastal fjord-stations, all in the southern half of Greenland. Of these, three are on the west coast, three on the east coast, and three on the south coast. The author himself has had no experience of Greenland, but had written his memoir from outside. If the outblowing wind system of Greenland had been taken into account, the isobars over the inland ice in Hovmöller's charts should all have made angles not greater than 45° with the surface contours. As a matter of fact, they take any direction, often directly across or at any angle which was necessary in order to get the cyclones across. This sumptuous memoir is in the realm of the imagination.

Future technique for meteorologists who study the Arctic climates. It has been indicated in the above that the explorer and the meteorologist have reached quite different conclusions concerning the climates of two vast Arctic regions.

The explorers find the Central Arctic Basin to be an almost windless region of uniformly normal atmospheric pressure. No evidence was found that cyclones cross it. The professional meteorologists

make it a vigorous fixed polar anticyclone area, but this is an hypothesis only.

The explorers have found Greenland to be covered over by a supervigorous glacial anticyclone fixed in position with outward-blowing winds everywhere. No cyclones cross it. The meteorological profession believes that Greenland is crossed by cyclones much as though it were an expanse of sea.[3] The great explorer-meteorologists, among others Alfred De Quervain and Alfred Wegener, and the explorer-scientist, Fridtjof Nansen, have taken their stand with the explorers.

An interesting consideration suggested by this discussion is whether in the future the technique of the meteorologist may change from one that has remained unchanged now for well-nigh a century. Will it give place to an objective one that makes observation of the weather *where it is,* not one theorized from somewhere else? If this is to happen, two factitious assumptions of the profession will certainly have to be abandoned. These are: (1) that the weather of a region must necessarily be determined by cyclones which invade it from outside; (2) that no weather observations can be used which have not been made at permanent stations fixed in position and with their observations repeated there over long periods of time.

This writer believes he can see the future meteorologist of the Arctic in a one- or two-man party lightly equipped and traveling rapidly across country. Several times each day he will halt, with a walky-talky report the geographical coordinates of his position, and send a weather report. Every few days he will acquire a fresh supply of food and fuel, delivered to him or cached for his use, either by submarine, aircraft, or truck, as may be most practicable. In his weather report essential accuracy will take the place of an unnecessary precision, for weather can vary so rapidly both in time and place that a refined precision seems to be superfluous. Location of the stations would in this system change frequently, but if the number of parties sufficed and their routes had been well laid out, there would be coverage for a daily weather chart.

[3] Glacial anticyclones like those now above the existing continental glaciers must also have overwhelmed the earlier ones which in Pleistocene time spread out over North America and Eurasia. Their deposits have heretofore been interpreted as though they had been like the little glaciers of the Swiss Alps but in a much expanded form. Extensive revision has in consequence already begun (Hobbs. The glacial anticyclone and the continental glaciers of North America. *Proc. Amer. phil. Soc.*, 1943, **86**, 368–402; The glacial anticyclone and the European continental glacier. *Amer. J. Sci.*, 1943, **241**, 333–336; American and Eurasian glaciers of the past: a picture based on existing ones. *Sci. Mon.*, 1948, **66**, 99–106; *Glacial Studies of the Pleistocene of North America.* Ann Arbor: Edwards Bros., 1947). Glacial geologists do not appear generally to have accepted the glacial anticyclones, and, supporting their position by that of the meteorological profession, they have published articles denying their existence. See *15*.

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NEWS and Notes

Gerhard Tintner, professor of economics, statistics, and mathematics at Iowa State College, has been granted a leave of absence to work with the research staff at the statistical laboratory at Cambridge, England. During the coming year Dr. Tintner will also give a series of lectures in economics and statistics to the Cambridge University undergraduate students.

James C. Warf was recently appointed assistant professor of chemistry at the University of Southern California. Dr. Warf, a Guggenheim Fellow now at the Chemisches Institut in Bern, Switzerland, was formerly associated with the Manhattan Project at Iowa State College.

Louis B. Howard, chief of the Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture, has resigned to become the first head of the year-old Department of Food Technology at the University of Illinois College of Agriculture. He will be succeeded by **G. E. Hilbert,** director of the Northern Regional Research Laboratory at Peoria, Illinois.

Horace N. Marvin, of the University of Arkansas School of Medicine, has been appointed head of the Department of Biology, M. D. Anderson Hospital for Cancer Research, Houston, Texas. At the Hospital, which is the state cancer hospital and a branch of the University of Texas, Dr. Marvin will be engaged in research on the relation of hormones to cancer and growth in general.

Irene Rosenfeld, research pathologist at the University of Wyoming, has been granted sabbatical leave from September 1 of this year to September 1, 1949, in order to accept an Atomic Energy Fellowship. She will conduct research at the Donner Laboratory, University of California, during that period.

H. A. Ireland, director of geologic research for the Standard Oil Company of Texas, and **A. G. Fischer,** of the staff of the University of Rochester, have been appointed professor of geology and instructor, respectively, at the University of Kansas. Dr. Ireland will teach courses in sedimentation and petrography, while Dr. Fischer will teach stratigraphy and elementary paleontology.

Grants and Awards

The $1,000 Paul-Lewis Laboratories Award in Enzyme Chemistry will be made to Albert L. Lehninger, assistant professor of biochemistry in the University of Chicago's Departments of Surgery and Biochemistry and a member of the University's Committee on Cancer, at the 114th national meeting of the American Chemical Society, which opens in Washington, D. C., on August 30. Dr. Lehninger's award address, on "Enzymatic Oxidation of Fatty Acids," will be delivered on September 2 at a symposium being conducted by the Society's Division of Biological Chemistry. The 31-year-old professor was cited, according to the ACS announcement, "for his research on the chemistry and metabolism of fatty acids, which has greatly increased man's understanding of the manufacture of body tissue and muscular energy."

The Biological Laboratories, 16 Clinton Street, Brooklyn, New York, has received from the Atomic Energy Commission, through the Office of Naval Research, a grant of $9,000 for a 6-month study of the effects of antisera on radiation damage. The work will be carried on under the direction of Norman Molomut, formerly of the Department of Medicine, College of Physicians and Surgeons, Columbia University, who organized the Laboratories in 1946 for the purpose of engaging in researches in physiology and microbiology.

Fellowships

Airborne Instruments Laboratory, Inc., Mineola, New York, has established two fellowships to aid worthy young men in obtaining advanced degrees in the field of communications and electronics, one valued at $1,000 plus tuition at Stanford University, the other in the amount of $1,200 plus tuition ($1,800 for a married man) at the Massachusetts Institute of Technology. Recipients are to be selected by the staffs of the Electrical Engineering Departments of the two schools.

The Socony-Vacuum Oil Company, Inc., has recently announced that it has appropriated $50,000 for a doubled program of fellowships in chemistry and physics at leading educational institutions. In addition to the 10 fellowships established last year and being continued for the 1948–49 academic year at California Institute of Technology, Harvard, Massachusetts Institute of Technology, Notre Dame, Ohio State, Princeton,

Rice Institute, Wisconsin, Illinois, and Yale, at least 10 more will be established for 1949–50 at institutions to be announced later. Recipients of these fellowships are selected by the universities from among students with at least one year of graduate work, and no restrictions are placed by the Company on the recipients as to future employment, publication of results of their investigations, or subjects of study.

The Company recently granted $250,000 to the Massachusetts Institute of Technology for basic studies of nuclear fission.

Colleges and Universities

The University of Kansas is offering a four-year course of study leading to a new degree in geologic engineering. Details of this course may be obtained from the office of the Department of Geology. According to Robert M. Dreyer, chairman of the Department, the curriculum is especially suitable for students desiring to do practical geological work after graduation and who do not wish to go on to do graduate work.

A High School Science Service was recently established at the University of Oklahoma "to assist in the improvement of general education in science in Oklahoma through the development of services for and bases of interaction between teachers and science clubs in the public schools and the science organizations of the University and other state and national science organizations; to assist in the location and identification of young people of promising scientific interests and capabilities at the earliest possible time in their school careers; and to develop an improved university program for the education of prospective and in-service science teachers in the public schools." Planned through an advisory committee consisting of staff members from a wide range of University departments and administered through its Extension Division, the organization is now equipped to provide a large number of services. Among these are technical reference and consultant service in both science and education; loan libraries; a monthly bulletin of science teaching and science club information in Oklahoma; and a weekly popular science radio program presented over the University's station, WNAD. A science fair, a two-day science teachers' conference, and publication of a series of science leaflets are planned during the next school year.

James G. Harlow, formerly director of science at Northeast High School, Oklahoma City, and at present an instructor in the University's Physics Department, is in charge of the new Service.

The new Los Angeles Division of the Stanford Research Institute opened on August 15, with headquarters in the Transamerica Building and with an initial staff of 15 people. Manager of the Division will be A. M. Zarem, former chief of the Electrical Section, Physical Research Division, U. S. Naval Ordnance Test Station, Pasadena, who will also serve as chairman of physics research. The Institute is currently carrying on numerous projects in the Los Angeles area. The smog problem, its cause, sources, and possible methods of control, is being studied extensively. Another project is an economic study to determine the expansibility of the aircraft industry in a national emergency, and still another is an evaluation of detergents for a Los Angeles firm in connection with patent developments. The Los Angeles Division staff will conduct research in a wide variety of fields of interest to southern California industry.

Industrial Laboratories

The General Electric Research Laboratory, Schenectady 5, New York, is distributing free to college departments of physics and chemistry and to other laboratories a new chart which gives the latest data concerning various forms or isotopes of the chemical elements. The chart, prepared by G. Friedlander and M. L. Perlman, Laboratory staff members, follows the general pattern of one previously devised by Emilio Segrè. It is printed on heavy paper, 26″ × 50″. Each square of the chart, in addition to the chemical symbol and atomic weight of the isotope, contains a good deal of other pertinent data. Those interested in having such a chart may obtain one by writing to the Company.

The Wm. S. Merrell Company has announced that J. Knox Smith, who recently obtained his Master's degree at the University of Wisconsin, and Raymond Eling, a recent graduate of the Cincinnati College of Pharmacy, have joined the Pharmacology and Bacteriology Departments, respectively.

Smith, Kline & French Laboratories announces that Arthur E. Heming, who has been associated with the Johnson & Johnson subsidiaries as chief chemist in charge of their research laboratories developing their pharmaceutical products in South America, has been appointed to its staff as a research biochemist.

The Merck Institute for Therapeutic Research has just announced the appointment of Richard E. Shope, a member of the Rockefeller Institute of Medical Research and an authority in the field of experimental medicine, as associate director. A new building is being constructed to provide Dr. Shope with special facilities for the study of animal pathology. He will join the Merck Institute staff upon its completion next spring.

Summer Programs

The Third Summer School for Teachers of Chemical Engineering will be held August 30–September 4 at the University of Wisconsin, Madison, under the joint sponsorship of the Chemical Engineering Division, American Society for Engineering Education, and Wisconsin. Nearly 60 experts and leaders in engineering and engineering education are scheduled to participate in the program of technical sessions on thermodynamics, unit processes, applied electrochemistry, kinetics, instrumentation, plastics, and teacher qualifications. Many outdoor recreational facilities will be available. More than 200 members of the Society and their families are expected to attend. The two previous summer schools of this kind were held at the University of Michigan (1931) and at Penn State (1939).

Meetings and Elections

Three international symposia are to be held in France this fall under the sponsorship of the Centre National de la Recherche Scientifique and with financial support provided by the Rockefeller Foundation. The first symposium scheduled is that on Vitamins and Anti-Vitamins, which will be held in Lyon from September 27 to October 4. D. W. Woolley, of the Rockefeller Institute for Medical Research, is expected to present a paper at this meeting. The second, on Reactions in the Solid State, will take place in Paris from October 1 to 6 under the presidency of G. Chaudron, of the Faculté des Sciences, University of Paris. According to CNRS, a number of foreign scientists have been invited to attend, including Drs. Hedvall, Hagg, and Bornelius, from Sweden; Drs. Mott, Garner, Barrer, and Brindley, from England; Dr. Feitknecht, from Switzerland; and Dr. Tetelaar, from Holland. Exact dates for the symposium on Electrophysiology, to be held at the Sorbonne in Paris and the Institut Marey, have not been set, but it is expected that they will fall in the last week of November or early in December. This symposium is being organized by Prof. Tessard, director of the Institut. Summary reports will be published in the *Revue Scientifique*, and the proceedings will appear in full at a later date.

U. S. scientists wishing to attend these symposia may obtain further information concerning them from the New York office of CNRS, 934 Fifth Avenue, New York City 21. Scientists abroad may contact the CNRS at 5ème Bureau, 13 Quai Anatole France, Paris VIIe.

The Fourth Annual National Conference on Industrial Hydraulics, under the sponsorship of the Armour Research Foundation, will be held October 20–21 at the Hotel Sheraton, Chicago. Present tentative plans call for two morning and two afternoon technical sessions with presentation of varied papers. As scheduled, the program will include a session on Recent Applications, under the chairmanship of J. T. Greenlee, Imperial Brass Manufacturing Company; one on Hydraulic Components, with B. A. Parks, of the Crane Company, acting as chairman; a session with T. M. Niles, of Greeley and Hansen, acting as chairman, which will discuss Pumps and Turbines; and a final session on Servomechanisms, which has been scheduled under Chairman C. J. Clark, of Ingersoll-Rand Company.

Information regarding the Conference may be obtained from S. F. Musselman, Assistant Chairman, Applied Mechanics Research, Armour Research Foundation, Technology Center, Chicago 16, Illinois.

The American Academy of Dental Medicine is planning to hold its annual midwinter meeting and luncheon at the Hotel Pennsylvania, New York City, on Sunday, December 5, at 12:30 P.M. Round-table discussions on dental-medical subjects will follow the luncheon. All Academy members as well as interested dentists and physicians are invited to attend. Further information may be obtained from Dr. William M. Greenhut, National Secretary, 124 East 84th Street, New York City 28.

The Sir Joseph Barcroft (1872–1947) **Memorial Conference on Hemoglobin** was held at Cambridge, England, June 15 through 17. According to David L. Drabkin, professor of physiological chemistry, Graduate School of Medicine, University of Pennsylvania, who participated in the Conference as chairman of the Haem Group and also presented a paper in one of the other sessions, "all the participators at this international conference were in agreement that it was an exceedingly valuable meeting of authorities in the field to which Joseph Barcroft had devoted much of his lifetime.

"The first morning session was given over to brief addresses upon Barcroft's life and work by a group of most distinguished scientists, including three Nobel Laureates. The remainder of the three days were spent in scientific sessions at which 25 individual contributions were presented, with lively discussions after each.

"The success of the hemoglobin conference was due in large measure to the effort of the initiator of the meeting, Prof. F. J. W. Roughton, and the local committee (Cambridge University), the members of which included Profs. D. Keilin, A. C. Chibnall, G. S. Adair, and M. Perutz.

"Cambridge fortunately has been untouched physically by the war, and those of the visitors who were housed in King's College will long remember not only the intellectual stimulus of the scientific meeting, but the gracious way of life in this great University."

The two-hour Memorial Session, under the chairmanship of E. D. Adrian, was addressed by H. H. Dale (London), A. S. Krogh (Copenhagen), C. G. Douglas (Oxford), A. V. Hill (London), R. A. Peters (Oxford), G. S. Adair (Cambridge), and F. J. W. Roughton (Cambridge). (Those unfamiliar with the work of Sir Joseph Barcroft might be interested in reading the obituary published in *Science*, August 22, 1947, pp. 160–161.)

The session on Comparative Physiology and Chemistry of Oxygen Carriers was under the chairmanship of A. S. Krogh, of Copenhagen, and had as participants H. Munro Fox (London), H. P. Wolvekamp (Leiden), and H. Davenport (Cambridge), while that on Chemical Analysis and Amino Acid Composition of Haemoglobin, Myoglobin, etc., of which J. T. Edsall, of Harvard University, was chairman, included papers by G. Rossi-Fanelli (Pavia), G. R. Tristram (Cambridge), and F. Sanger and R. E. Porter (Cambridge). Dr. Drabkin's session on the Haem Group included contributions by L. C. Pauling (California Institute of Technology), J. Wyman (Harvard University), and F. Haurowitz (Istanbul); the metabolic aspects of haem and haemoglobin were discussed by A. Vannotti (Lausanne) and C. Rimington (London). The session on Specificity of Haemoglobin —Differences Between Foetal and Adult Haemoglobin, of which Dr. Haurowitz was chairman, was participated in by M. Karvonen (Cambridge and Helsinki), J. R. P. O'Brien and Mrs. H. M. Jope (Oxford), and J. H. P. Jonxis (Rotterdam). W. N. M. Ramsay (Edinburgh) and H. Barcroft and Q. Gibson (Belfast) discussed some chemical and physiological aspects of haemoglobin. Dr. Pauling served as chairman of the session on X-Ray Investigation of Crystalline Oxygen Carriers, with M. Perutz and

J. C. Kendrew (Cambridge) as participants. Another session, on Physical Chemistry of Haemoglobin, included papers by Dr. Drabkin, G. S. Adair (Cambridge), and F. J. W. Roughton, J. W. Legge, and M. Nicholson (Cambridge). Following demonstrations in the Molteno Institute and a tea on the afternoon of June 17, D. G. Dervichian (Paris), M. Jope (London), and Chr. de Duve (Louvain) presented papers before a session on Physical Chemistry of Haemoglobin and Red Cells, which was under the chairmanship of F. J. W. Roughton. The final hours of the day were devoted to a paper on "Thermodynamic Analysis of Some Reversible Reactions of Haemoglobin in Solution," by H. Gutfreund of Cambridge.

Early publication of both the memorial addresses and the scientific papers is being considered.

A Symposium on Ecologic and Genetic Factors of Speciation in Animals was held by the Istituto Italiano di Idrobiologia, Pallanza (Novara), Italy, from July 29 to August 2, under the sponsorship of the Consiglio Nazionale delle Ricerche (Italian National Research Council), whose general secretary, Comm. Dr. A. Morelli, opened the Symposium. Thirty-four biologists attended. A. Buzzati-Traverso, head of the Institute's Department of Genetics, reports that papers were read by E. Baldi ("Isolation Mechanisms in Populations of Plankton Fresh-Water Crustaceans"); M. Benazzi, Pisa ("Genetic-systematic Studies on Triclades"); F. G. Brieger, Piracicaba ("Heterosis in Population-Genetics and Evolution"); H. Burla, Zürich ("On the Ecology of *Drosophila* Species of Switzerland"); U. D'Ancona ("Nemi's Daphniae During 25 Years of Observations"); A. Dreyfus, São Paulo ("Sex Ratio in Hybrids and Its Interpretation by the Study of Salivary Chromosomes"); M. Galgano, Florence ("Ecologic and Genetic Factors in the Sexual Cycle of the Amphibians"); J. B. S. Haldane, London ("The Importance of Disease in Evolution and Speciation"); J. Heuts, Louvain ("Ecologic and Genetic Factors in the Speciation of the Fish *Gasterosteus aculeatus*"); F. Mainx, Wien ("Chromosomal Races of the Agromyzine *Lirryomiza*"); B. Rensch, Münster ("Histologic Transformations by Changes in Body Size"); H. Spurway-Haldane, London ("Some Comments on Vavilov's Law of Homologous Variation"); V. Tonolli, Pallanza (High-Mountain Diaptomids Populations' Isolation and Stability"); and L. Trevisan, Pisa ("Remarks on the Evolution of the Elephants During the Quarternary"). Th. Dobzhansky, of Columbia University, introduced the theme for discussion and at the end of the meeting commented upon the papers presented. The papers are to published in a special volume, edited by the Consiglio Nazionale delle Ricerche.

The American Society for the Study of Arteriosclerosis recently elected the following officers: William B. Kountz, president; Irvine H. Page, vice-president; O. J. Pollak, of Quincy City Hospital, Quincy 69, Massachusetts, secretary-treasurer; and as directors for the 1948–49 term, G. Lyman Duff and Robert A. Katz; for the 1948–50 term, E. C. Andrus and Myron Prinzmetal; and for the 1948–51 term, Louis N. Katz and Henry S. Simms.

The 1948 annual scientific meeting of the Society will be held October 31–November 1 at the Hotel Knickerbocker in Chicago. Members are urged to make hotel reservations immediately.

The American Standards Association was incorporated under the laws of New York State on August 2. The Association was organized in 1918 as the American Engineering Standards Committee, a coordinating committee for the standardization work of 5 of the country's important technical societies. Subsequent broadening of scope and organizational setup to include associations and government agencies led to the extension of the work into the field of safety standards, and in 1928 a complete reorganization took place, the Committee being changed to the American Standards Association, which has served as the Nation's clearinghouse for standards and the U. S. medium for international contacts on standardization. Still further enlargement of activities has led to its present incorporated status. Bills seeking Federal incorporation have been introduced into both the House and the Senate. The Association's coordinating functions now extend to standards in the mechanical, electrical, building, photographic, mining, safety, and consumer goods fields, and in addition, general work is done on office equipment and abbreviations and symbols for use in scientific literature.

Frederick R. Lack, vice-president of Western Electric Company, is president of the incorporated Association and Vice-Adm. G. F. Hussey, Jr. (USN, ret.) is secretary and administrative head.

A new periodical covering all branches of plant physiology has recently appeared. This quarterly, issued under the title *Physiologia Plantarum*, is to be the official publication of the Scandinavian Society for Plant Physiology and is open to contributions from Scandinavian and foreign members of the Society. Papers are to be printed in English, French, or German. Prof. H. Burström, of the Botanical Laboratory, Lund, Sweden, is editor-in-chief. The subscription price for nonmembers is 40 Danish Kroner (about $8.00). Subscriptions may be placed with Einar Munksgaard, Norregade 6, Copenhagen, Denmark.

Make Plans for—

Electron Microscope Society of America, annual meeting, September 9–11, McLennan Laboratory, Department of Physics, University of Toronto, Canada.

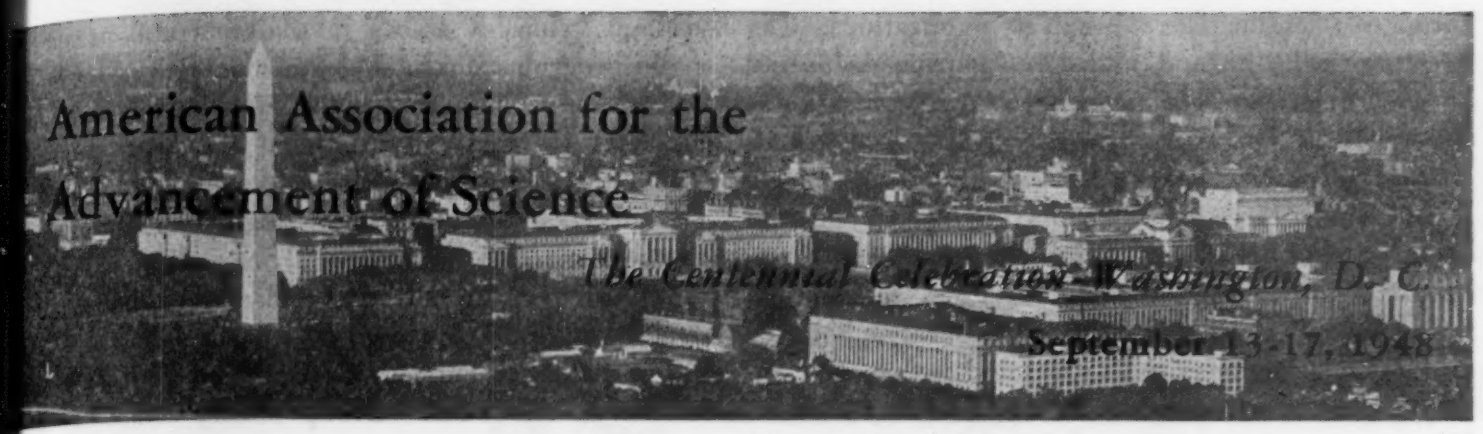
Human Genetics Society of America, first meeting, September 11–12, Washington, D. C.

Society of Systematic Zoology, September 12, Washington, D. C.

American Chemical Society, western session of 114th meeting, September 13–17, Portland, Oregon.

Laurentian Hormone Conference of the AAAS, September 13–15, Forest Hills Hotel, Franconia, New Hampshire.

La Société de Chimie Biologique, 8th Congress, October 6–8, Paris, France.



The American Chemical Society

The American Chemical Society, the world's largest body devoted to a single science, seeks to encourage in the broadest and most liberal manner the advancement of chemistry in all its branches, the promotion of research in chemical science and industry, the improvement of the qualifications and usefulness of chemists through high standards of professional ethics, education, and attainments, the increase and diffusion of chemical knowledge, and, by its meetings, professional contacts, reports, papers, discussions, and publications, to promote scientific interests and inquiry, thereby fostering public welfare and education, aiding the development of our country's industries, and adding to the material prosperity and happiness of our people.

The Society had its beginnings in New York City on April 20, 1876, when a group of 35 chemists banded together, organized, and elected officers. It was incorporated in New York State on May 9, 1877, and was reorganized on a national basis in 1891. Its standing and importance were recognized by an Act of Congress effective January 1, 1938, under which it was granted a Federal charter on January 7, 1938.

Membership in the Society is divided into the following classes: senior grade, junior grade, life, emeritus, honorary, and corporation. Members in all classifications enjoy the full privileges of the Society except that corporation and junior-grade members may not hold office. The chief administrative officers include the president, president-elect, chairman of the Board of Directors, executive secretary, and treasurer. The present officers are: Charles A. Thomas, president; Linus Pauling, president-elect; Roger Adams, chairman of the Board; Alden H. Emery, executive secretary; and Robert V. Mellefont, treasurer.

Early in 1941 the Society purchased as national headquarters a 5-story and basement building at 1155 16th Street, N.W., Washington, D. C., which now houses the offices of the secretary and treasurer and the main editorial offices of *Industrial and Engineering Chemistry, Analytical Chemistry,* and *Chemical and Engineering News.* From its modest beginning, the Society has now grown to a membership of approximately 58,000.

The Board of Directors is the legal representative of the Society and consists of the president, president-elect, most recent past-president, 6 regional directors, and 4 directors-at-large chosen specifically for their business experience and ability. The popular deliberative assembly of the Society is the Council, composed of the president, president-elect, past-presidents, executive secretary, treasurer, directors, editors of each journal published by the Society, two councilors from each division, and at least one councilor from each local section and more in proportion to the section's membership.

The Society has 18 divisions, which are professional groups organized from among its membership to stimulate and develop the growth of the special activity assigned to them. The Society also has 127 sections scattered throughout the country. These sections are given territory with headquarters where members may be reasonably expected to attend meetings held at stated times from September until June.

Much of the business of the Society is conducted through committees. The Council has two highly important committees—the Council Policy Committee and the Committee on Nominations and Elections—and the following standing committees: Committee on Membership Affairs, Committee on National Meetings and Divisional Activities, Committee on Local Sectional Activities, Committee on Professional Relations and Status, Committee on Publications, Committee on Education, and Committee on Constitution and Bylaws. Other committees, such as the Committee on Professional Training, Membership Committee, Committee on Nomenclature, Spelling, and Pronunciation, and the various awards committees, are appointed as occasion demands and are responsible for carrying out some part of the Society's program. Still other committees have to do with technical problems.

The Society conducts a broad and far-reaching program, the most important part of which is the dissemi-

nation of scientific data through its publications. The Society owns, edits, and publishes 5 journals—*Journal of the American Chemical Society, Chemical Abstracts, Industrial and Engineering Chemistry, Analytical Chemistry,* and *Chemical and Engineering News,* the last three mentioned having branch editorial offices in Chicago, Houston, New York, and San Francisco. Prior to each national meeting, through its ACS News Service, the Society prepares a book of abstracts of all papers to be presented at that meeting. The Society also has editorial responsibility for the Monographs of the ACS, published by the Reinhold Publishing Corporation and edited by W. A. Hamor, Mellon Institute, Pittsburgh, Pennsylvania. One hundred and six of these monographs have been issued, as well as various revised editions, and many more are in preparation.

The *Journal of Physical and Colloid Chemistry* is published 9 times a year under the auspices of the American Chemical Society and the Faraday Society. *Chemical Reviews,* issued bimonthly, is owned and edited by the Society and published by the Williams and Wilkins Company. The *Journal of Chemical Education* is the official organ of the Society's Divisions of Chemical Education and the History of Chemistry. The quarterly journal, *Rubber Chemistry and Technology,* is owned, edited, and published by the Society's Division of Rubber Chemistry. Many of its local sections sponsor publications.

The American Chemical Society administers 9 awards in recognition of outstanding services to chemistry. The Society itself finances and awards the Priestley Medal, the greatest honor that can be bestowed in American chemistry. The local sections administer 9 awards.

The News Service, of which Walter J. Murphy is director, serves as a clearing house of chemical information for the press, science writers, columnists, and radio commentators. It gathers material from individuals, local sections, divisions, and Society officers, rewrites it for use by newspapers, press associations, syndicates, radio broadcasting companies, and technical publications, and disseminates it both here and abroad.

About 18 months ago the News Service extended its activities by the establishment of a radio department which inaugurated weekly broadcasts—now a permanent feature—on chemical science and technology, known as Headlines in Chemistry. This service has greatly extended itself through the local sections, which it assists in planning and preparing radio programs throughout the country.

The Society has a diversified meeting program, foremost on it being two national meetings annually. These afford an unparalleled opportunity for chemists and chemical engineers to get together from all over the country and foreign countries as well, exchange views, broaden friendships, and acquire information over a wide field of chemistry. At these meetings scientific papers amounting to many hundreds are presented in one week. Group meals, committee and special group meetings, "lobby sessions," all afford excellent opportunity for people with similar interests to get together. Some of the divisions hold annual meetings or biennial symposia between national meetings, and often regional meetings are held in various sections of the country. The latter are small national meetings in general plan and provide an opportunity to get together for people who for some reason cannot attend the national meetings. Each has its own special advantages.

The Society, since the spring meeting in 1937, has operated an Employment Clearing House at each national meeting. This service is open to chemists registered and in attendance at the meeting and, at the request of employers, arranges interviews between them and candidates for employment. In 1947 the Clearing House served 1,650 employers' representatives and 1,450 candidates for employment. In order that the service may operate on a continuous basis, regional employment clearing houses are also operated in Atlanta, Boston, Chicago, Houston, New York, San Francisco, and Washington, D. C. Each issue of *Chemical and Engineering News* also contains employment information pages where situations open and situations wanted are listed.

In 1945 the Society created an ACS Education Fund for awarding predoctoral fellowships in 1946. It also appropriated $110,000 for postdoctoral fellowships in chemistry and chemical engineering, and in September 1946 appropriated $25,000 for expenses in the United States of foreign chemists and chemical engineers wishing to engage in advanced study.

Its advice is frequently sought in national affairs, particularly on pending legislation such as Selective Service, the National Science Foundation bills, etc.

The American Chemical Society, since its establishment more than 72 years ago, has sought to promote the advancement of chemistry, chemical research, and chemical engineering in an ever-widening sphere.

The American Chemical Society is another of the many organizations which are serving as hosts during the AAAS Centennial Celebration. The ACS building, shown on this week's cover, is located one block from the AAAS headquarters.

TECHNICAL PAPERS

he Dreywood Anthrone Reaction as ffected by Carbohydrate Structure

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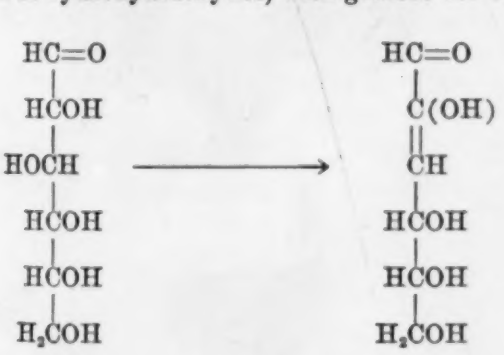
The recent work of Roman Dreywood (*1*) and of niel Luzon Morris (*3*) has shown that anthrone in furic acid is a general reagent for carbohydrates, in-ding sugars, polysaccharides, glycosides, carbohydrate ers, and esters. The writers have confirmed this by ts with methylated glucose, diheterolevulosan, levulose aacetate, maltose octaacetate, hydroxymethylfurfural, d the diphenylacethydrazide of hydroxymethylfurfural. wever, the phenylosazones of glucose and galactose d the phenylosotriazole of glucose do not give this t, whereas mannose phenylhydrazone gives a positive ction. These facts must be connected in some way th the structure of these compounds. The osazones d osotriazoles differ from the other compounds by lding osones with strong acids, while the hydrazones e reconverted to the original sugars. These, in common th the other carbohydrates and carbohydrate derivatives ntioned previously, initially split off water, with the rmation of hydroxyaldehydes, with glucose for example:



his was postulated by Hurd and Isenhour (*2*) and con-med by Wolfrom, Schuetz, and Cavalieri (*5*). By rther loss of water and ring formation the hydroxy-ehyde goes over to hydroxymethylfurfural. In an alogous manner pentoses yield furfural, and hexo-thyloses yield methylfurfural. The anthrone reaction s substantiates this mechanism.

Incidentally, the anthrone reagent gives a cherry-red lor with ascorbic acid and a negative test with ulinic acid, acetol, and methylglyoxal.

The study of the anthrone reaction further suggested e testing of melanoidins for residual sugar groups, ce these substances are high polymers and Dreywood) obtained a positive reaction with cellulose plastics. e natural melanoidin extracted by Weast and MacKin-y (*4*) from sun-dried apricots gave a negative test, but the synthetic melanoidin prepared by heating a solution containing fructose and aspartic acid, and having practically the same elementary composition as the natural product, gave a positive carbohydrate reaction.

In view of the fact that the anthrone reaction seems to require the presence of a furfural structure, the above observations lend support to our belief that melanoidins may be produced in two ways. The first way is through the formation of 3-carbon fragments (acetol, glucic acid, methylglyoxal) which polymerize and then react with amino acid. The reaction is favored by mild temperature conditions such as obtain in the drying of apricots. The second route leading to melanoidin formation requires higher temperatures, and under these conditions hydroxymethylfurfural is formed, which then yields melanoidins by reacting with amino acid.

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Inhibition of Hair Growth by the Percutaneous Application of Certain Adrenal Cortical Preparations

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Accumulating evidence suggests that the adrenal cortex may act as an inhibitor of hair growth. Butcher (*2*) and Ralli and Graef (*5*) found in the adult rat that replacement of hair on depilated areas of skin is accelerated by adrenalectomy. Another report by Butcher (*4*) points to the cortical part of the gland as being responsible for this effect. He also found (*3*) that the skin of the adrenalectomized rat exhibits an increased rate of oxygen consumption paralleling the increased rate of hair growth. Ralli and Graef (*5*) observed that melanin deposition in hair is also stimulated by adrenalectomy under conditions that ordinarily inhibit its production. The same workers (*6*) discovered that injected desoxycorticosterone acetate and, to a lesser degree, adrenal cortical extract prevented the stimulation of hair growth and melanin deposition which otherwise follows adrenalectomy in the black-hooded rat. The following experiment was conducted to determine whether or not various adrenal cortical preparations might exert an inhibiting influence on hair growth when applied directly to the skin.

Any study involving the rate of hair growth in the rat demands recognition of the cyclic nature of this growth. Butcher (*1*) found that, up to the age of 90 days at least, there are alternating periods of growth and quiescence. Each period is about 17 days in length. Thus,

FIG. 1

a hair grows for about 2½ weeks and then stops. After the rest period the follicle resumes activity by starting another hair, while the first will remain for a variable period and then fall away. Secondly, not all of the follicles of the body are producing hair at one time, although all follicles within a limited region are synchronous in their activity. At any one time the pattern of growth falls into one of a number of fairly well-defined configurations. Fig. 1, a photograph of an alcohol-treated control rat, illustrates one of the normal patterns on the neck in which the active areas are bands extending caudad from the ears. This hair had grown during the preceding week. None had grown along the midline or on the extreme lateral aspect of the neck. These patterns are, with minor variations, bilaterally symmetrical. Furthermore, a dark pigment is present in the skin during the time that dark hair is being formed. Such pigmentation is not apparent during the period of follicular quiescence.

The cutaneous area chosen for study was the dorsolateral aspect of the neck. This region was selected because it is one from which the animal is least likely to remove, by licking or scratching, any materials applied thereon. The hair was clipped from this and adjacent areas at weekly intervals. The extent of replacement of hair on the denuded area was recorded by sketches or photographs a week later. By this means the hair growth patterns became evident.

Albino rats of the Wistar strain and black-hooded animals of the Long-Evans strain were used. They were divided into 3 groups and treated daily by applying measured amounts of material onto the skin of the right dorsal side of the neck with a tuberculin syringe without a needle and by rubbing lightly. The 5 animals of Group I received 0.1 ml of adrenal cortical extract[1]; the 13 animals of Group II, 0.1 mg of 11-dehydro-17-hydroxycorticosterone in 0.1 ml of 25% ethyl alcohol[1]; and the rats of Group III, 0.1 ml of 25% alcohol. Not only did the animals of Group III serve as controls, but also the left untreated side of all of the animals served as references for the study of the alteration of growth rate in areas under treatment.

Within 3 weeks after initiation of treatment the replacement of hair was stopped on all animals in the areas treated with 11-dehydro-17-hydroxycorticosterone. This inhibition is illustrated by the interruption of the band of hair caudal to the right ear of the rat pictured in Fig. 2 as contrasted with the continuous band on the left side. The region of inhibited growth coincided with the area to which this purified cortical hormone was applied. Neither hair nor pigment appeared in this area during the 6 weeks of treatment. Inhibition of hair growth occurred also in the animals receiving the aqueous cortical extract, but to a lesser degree. The effect on hair growth in these rats after 6 weeks of treatment corresponded roughly with the results in the animals treated for 2 weeks with 11-dehydro-17-hydroxycorticosterone.

FIG. 2

Histological examination of biopsy samples of skin from the areas treated with this cortical fraction show that true inhibition of hair growth had occurred. No detectable change in the rate of hair replacement was produced by the use of 25% alcohol on the controls.

It appears from these studies that at least one of the 11-oxysteroid hormones of the adrenal cortex (11-dehydro-17-hydroxycorticosterone) is able to exert a direct depressing effect on the growth of hair in the rat. It is this group of compounds that is known to exert a

[1] The aqueous cortical extract and the 11-dehydro-17-hydroxycorticosterone were supplied by J. J. Pfiffner, of Parke, Davis & Company.

eogenic action in general metabolism. Apparently, action is accomplished, in this case, by some local chanism in the tissue to which it is applied. It does depend on the intermediary action of any recognized ocrine gland and, in the doses employed, affects no follicles not directly treated. The less significant wth-inhibiting potency of the aqueous cortical extract ees with biological assay of the material, showing it to tain "gluconeogenic" steroids in low concentration. Detailed histological and histochemical analysis of treated skins and other studies of the action of adrenal tical hormones on growth will be reported elsewhere.

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fect of 2,4-Dichlorophenoxyacetic Acid Root Development in Bean Cotyledons

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One of the well-known effects of plant-growth regula- on plants is the forced production of roots in various ised as well as intact organs of the shoot. In addition being an excellent selective herbicide, the synthetic nt-growth regulator, 2,4-D, is also a good root-in- ing compound.

In the course of an experiment in which the per- tence of 2,4-D in soils is being studied, it was erved that the cotyledons of garden beans (*Phaseolus garis* L. var. Lualualei)[1] planted in certain soils ated with 2,4-D (10 lbs/acre of 95% acid dusted on il surface) developed roots. As far as is known to the ter, this is the first reported instance of this phe- menon. Although the root primordia are capable of eloping in any part of the cotyledon, they seemed to elop more frequently in the basal portion. The first ect of the 2,4-D in the soil on the bean was the dying rotting of the young, growing, embryonic axis, lowed by the rotting of the cotyledons. After the bryonic axis died and if the cotyledons survived the ects of the 2,4-D, the latter remained turgid and eloped root primordia. These rooted cotyledons, how- r, failed to develop any shoots when they were nsferred to normal untreated soil. In a few cases, ts were observed on exposed cotyledons which were ll intact on the stems of bean seedlings growing in -D-treated soil.

In order to prove that the roots observed above did develop from axillary buds in the embryo after the mary root had died as a result of the presence of 2,4-D the soil, the following experiment was conducted. Garden beans of the variety Bountiful were soaked in tap water at room temperature for 3 hrs. After the soaking period, the testa was removed from each swollen bean, and the cotyledons were separated. The germ end of each cotyledon (approximately one-fourth of the length of the cotyledon) was then severed to remove the embryonic axis entirely. The excised cotyledons were planted in soil previously treated with 2,4-D (5 lbs/acre of 95% acid dusted on soil surface). Similar cotyledons were planted in untreated soil. Twelve days after planting, the cotyledons were dug up and examined. It was observed that about half the number of the cotyledons in the 2,4-D–treated soil had developed roots, whereas none in the untreated soils showed any signs of root development (Fig. 1). These roots could not have developed from the axillary buds in the embryo.

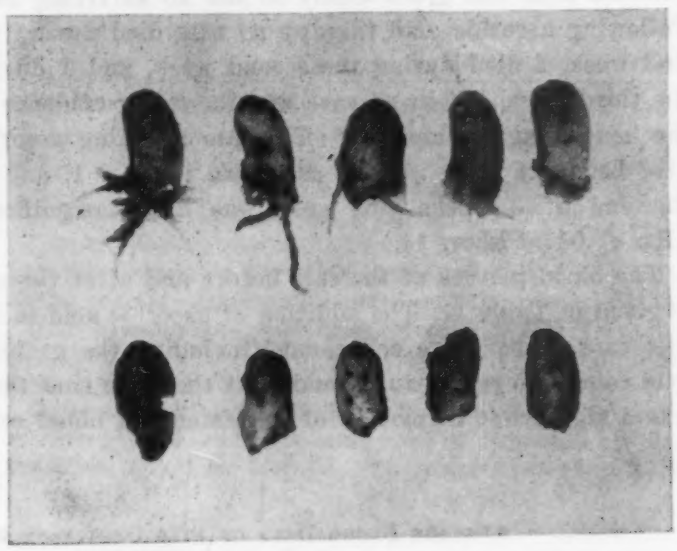

FIG. 1. Cotyledonary roots induced by 2,4-D: above, in 2,4-D-treated soil; below, in untreated soil.

An attempt was made to induce root development in bean cotyledons on filter paper in Petri dishes containing 2,4-D solutions varying in concentrations from 1 to 32 ppm. Three temperatures were employed for each concentration: room temperature (74.9°–86.0° F), 84.9°–93.5° F, and alternation between these temperatures (8 hrs at the higher and 16 hrs at the lower temperature range daily). The germ ends of Bountiful beans were excised before being placed in Petri dishes containing the 2,4-D solutions (15 cc). Two days later, the testa from each bean was removed, and the cotyledons were separated and allowed to remain in the Petri dishes. After two weeks it was observed that all concentrations of 2,4-D used induced rooting of the cotyledons. At room temperature and at alternating temperatures the cotyledons rooted most readily at 2–8 ppm of 2,4-D. At 84.9°–93.5° F they rooted most readily at 1–4 ppm. At the highest temperature range, the cotyledons rooted slightly more readily than at room temperature or at alternating temperatures, and the latter two temperatures were about equal in their root-inducing capacity. In this experiment, one cotyledon (6% of total) in the distilled water control at room temperature produced roots. In no other case did an untreated cotyledon produce roots, whether cultured in Petri dish or in soil.

[1] Supplied by Truck Crops Department, Hawaii Agricultural Experiment Station.

Ascorbic Acid Therapy of Pteroylglutamic Acid-Deficient Rats

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Division of Animal Nutrition, University of Illinois, Urbana

A typical pteroylglutamic acid-deficiency syndrome was produced in 20 rats by feeding a "synthetic" diet[1] containing 2% Sulfathalidine or Sulfasuxidine. Growth ceased after 5 weeks on this diet, and 5 rats had died at the end of the 7th week. All of the rats which died and many of the surviving ones had a hemorrhagic condition particularly noticeable around the mouth and nose and on the paws. At this time approximately 2 mg/day of ascorbic acid was given orally to the 15 surviving rats. Following ascorbic acid therapy no rats died during the first week, 2 died during the second week, and 1 during the third week, but in no case was there any evidence of the hemorrhagic symptoms. The rats receiving ascorbic acid began to gain weight, as shown in Fig. 1, and at the end of 3 weeks this gain was highly significant ($P = < .01$; Fisher, *1*).

The blood picture of the rats before and after therapy is given in Table 1. The addition of ascorbic acid to the diet caused the white cell count (including the granulocyte count) to return to normal. At the same time there was a significant formation of nucleated red blood cells, a continued decrease in hemoglobin and total red cell count, and a normal per cent of reticulocytes.

After 3 weeks on ascorbic acid, 6 of the rats were given orally 50 γ of PGA/day, and the blood picture examined 2–3 days later. The administration of P

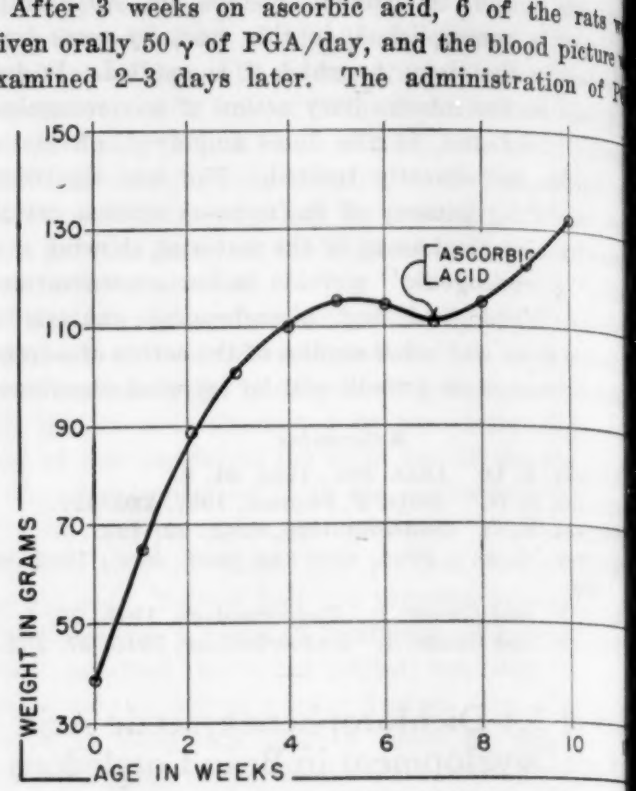

Fig. 1. Growth curve of PGA-deficient rats. Effect of ascorbic acid.

caused a marked reticulocyte response but no significant increase in the number of nucleated red blood c ($P = < .38$). These data confirm the known role of P in red blood cell maturation and hemoglobin formati

TABLE 1

Average Blood Data of PGA-Deficient Rats Before and After Ascorbic Acid Treatment

Date	Hemoglobin (gm/100 ml)	Red blood cell count (millions/mm³)	White cell count (No./mm³)	Granulocyte count (No./mm³)	Lymphocyte count (No./mm³)	Monocyte count (No./mm³)	Nucleated red blood cells (No./100 W.C.)	Reticulocytes (%)
1/18		Experiment started						
2/10	15.0*	6.58	8,000	825	7,055	120	0	...
3/1	12.19*	6.55	3,920*	182*	3,702*	31	0.1	...
3/8		Ascorbic acid treatment started						
3/17	8.85*	4.63*	....	699	6,016	178	10.9*	...
3/23	....	...	7,210	1,956	5,840	79	26.8	4.5*
3/30		PGA treatment started						
4/2	....	...	....	....	....	...	46.2	18.7*

* The starred values are statistically different than any other value in the same column; $P = < .01$ by Fisher t (not tested, in the case of monocyte counts).

This PGA-vitamin C interrelationship may be rel to that reported by Woodruff and Darby (*3*), who sho that PGA functions in correcting the abnormal tyro metabolism of the scorbutic guinea pig. It may also related to that reported by Lepp, Moore, Elvehjem, Hart (*2*), who reported an effect of vitamin C on he globin production in PGA-deficient chicks.

[1] Casein, 20%; Cerelose, 68%; cod-liver oil, 2%; minerals, 4%; corn oil, 4%; sulfa drug, 2%; and the following vitamins/kg of ration: thiamin, 2.5 mg; riboflavin, 5 mg; nicotinic acid, 10 mg; pyridoxine, 2.5 mg; Ca pantothenate, 20 mg; inositol, 100 mg; biotin, 0.1 mg; 2-methyl-1,4-naphthoquinone, 1 mg; and choline, 1 gm.

It appears that in the PGA-deficient rat the leucopenia can be effectively treated with ascorbic acid. It is also possible that ascorbic acid functions in the formation of normoblasts but PGA is required for red cell maturation. The application of these findings to the treatment of pernicious anemia and sprue has yet to be investigated.

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The Reducing Properties of Serum From Subjects With Malignant Disease

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In 1944 Savignac (*2*) published experiments on the reducing properties of serum. He heated serum at pH 11 for 10 min and, at room temperature, measured under partially anaerobic conditions the time required to reduce a given amount of methylene blue. Savignac concluded that sera from patients with malignant diseases showed a significantly longer reduction time than sera from subjects without malignancy. Recently Black (*1*) reported similar experiments, using a modification of the Savignac method. He concluded that "plasma of patients with malignant diseases tended to have a lowered reducing power and could be differentiated with a high degree of accuracy."

A considerable amount of work on the biochemistry of this phenomenon has been done in this laboratory, and the following conclusions can be made:

(1) Methylene blue is reduced slowly by unheated serum. Heated alkaline serum rapidly reduces methylene blue. It can be easily shown that heating converts a large part of the bound sulfur of protein into sulfide ions (the so-called "labile sulfur"); sulfide ion is insignificant in unheated serum. The reduction of methylene blue is due *solely* to the presence of newly formed S^{--}. When the sulfide ion is removed by appropriate methods, reduction of methylene blue is insignificant (see Table 1). It is therefore more correct to state that the phenomenon under discussion is the anaerobic oxidation of sulfide ion by a suitable hydrogen acceptor such as methylene blue.

(2) Sulfide ion in aqueous solution is oxidized very slowly by methylene blue. The addition of heated or unheated serum, however, greatly accelerates the rate of oxidation. In other words, by some mechanism not yet established, serum catalyzes the oxidation of S^{--}. This peculiar catalytic activity is not specific for any one protein constituent of serum, but is observed with all purified protein components of serum as well as with other proteins, viz.: serum albumin, alpha globulin, beta globulin, fibrinogen, insulin, edestin, urease. It is not observed with starch. The catalysis can be demonstrated by aerobic as well as anaerobic methods.

(3) When known and varying amounts of sulfide ion are added to unheated or heated serum, the reduction time of methylene blue can be expressed with considerable accuracy by the equation $t = k/\sqrt{S^{--}}$. In other words, the reduction time is an indirect but crude method for the estimation of S^{--}, *i.e.* the "labile sulfur" of the serum. This is further established by the fact that the sulfide ion in heated serum (determined by iodometric titration) is significantly correlated with the reduction time.

(4) The catalytic activity of serum in bringing about the anaerobic oxidation of known amounts of added sulfide ion by methylene blue is greatest with unheated serum. Heated serum with the same amount of sulfide ion requires 3–10 times longer, depending upon the concentration of sulfide.

(5) In 315 experiments on sera from miscellaneous patients there was no significant relation between the reduction time of methylene blue, as measured in a variety of ways, with the presence or absence of malignancy. Quantitative measurements of "labile sulfur" in these sera also failed to show any such relationship. These data lead to conclusions contrary to those of Savignac and Black cited above.

TABLE 1

Serum RS-12 (2/16/45): Add 0.20 ml of 1.25 N NaOH/ml of serum. Heat (100° C) for 10 min. Place three portions of 1 ml each into Thunberg tubes with 1 ml of 0.1% methylene blue in side sacs. Treat the samples as follows:

(A) *Control*: Add 0.1 ml of saline.

(B) *Secondary control:* Add 0.10 ml of 5 N HCl,* let stand without evacuation for same time as C, then add 0.12 ml of NaOH exactly equivalent to added acid to restore original pH.

(C) *Experiment*: Add 0.10 ml of 5 N HCl,* evacuate 3 min, and add 0.12 ml of NaOH exactly equivalent to added acid.

After restoration of alkaline pH, evacuate all tubes, admix methylene blue, and determine time of reduction by the conventional Thunberg Method. The results are given below.

Tube No.	Reduction time (sec)	Final sulfide ion (iodometric titration) (micromole/ml of serum)
A	90	29
B	70	29
C	> 1,800	7
Original unheated alkaline serum		0

* Since pK of H_2S is 6.5, it is necessary to bring to pH ca. 5.5 to remove sulfide by evacuation. The amount of acid needed to bring the alkaline serum to pH 5.5 was determined independently. S^{--} cannot be removed from alkaline solutions by evacuation.

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IN THE LABORATORY

Studies on an Artificial Kidney: I. Preliminary Results With a New Type of Continuous Dialyzer[1]

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A rational approach to the treatment of acute renal insufficiency demands the removal from the body of retained metabolic waste products. This has been attempted by plasmapheresis, exchange transfusions, diaphoresis, and purgation, all of which have been abandoned as impractical. Continuous lavage of the intestine has also been advocated (*12, 14, 16*), but such small amounts of nitrogen can be thus removed that its usefulness is doubtful (*15*). Peritoneal lavage has been successful in animals (*1, 4, 15*) and in man (*5, 6, 7*), but the attendant danger of infection, clogging of the draining tubes, and the necessity of almost continuous operation have forestalled wide application.

Abel, Rowntree, and Turner (*2*) in 1914 first devised an apparatus for the removal of diffusible substances from the circulating blood of living animals by dialysis. Although they realized the possible usefulness of the method in the treatment of uremia, only recently have Kolff (*9, 10*), Alwall (*3*), Murray (*13*), and others (*11*) made serious attempts to apply it clinically. Although differing in constructional details, all of their "Artificial Kidneys" are characterized by their large size and the use of long lengths (100′) of cellophane tubing, necessitating complicated procedures for assembly and sterilization.

Although the above methods have not yet been generally accepted for routine use, they have met with sufficient success to demonstrate that life can be prolonged during temporary acute renal insufficiency through the removal of retained metabolic waste products and the adjustment of acid-base, electrolyte, and water balance.

The present report describes preliminary results with a new design of a continuous dialyzer (Fig. 1) which consists of a variable number of units, connected in parallel, each unit consisting of a single sheet of Cellophane and two rubber pads, each 12″ × 18″ × ¼″. The Cellophane is sandwiched between the two rubber pads, the inner surfaces of which are finely grooved. The grooves on one of the pads serve as small "vessels" through which blood is allowed to flow under arterial (or other) pressure. The grooves of the other pad (on the other side of the Cellophane) carry dialyzing solution moving in the opposite direction. Thus, a single kidney unit is formed which may be connected with as many similar units as desired by means of interconnecting passages provided for within the rubber pads themselves.[3] The desired number of units are held firmly between two flat steel plates drawn together at the edges with thumbscrews. The entire assembled apparatus, ready for use, may be sterilized by autoclaving. Each kidney unit presents a surface area for dialysis of 840 cm², contains 45 ml of blood, and, under optimal conditions, is capable of removing 0.5 gm of urea nitrogen/hr from a blood urea nitrogen level of 150 mg/100 ml. Preliminary experiments have indicated that a similar dialyzing area may be obtained with the "kidney unit" holding much less blood.

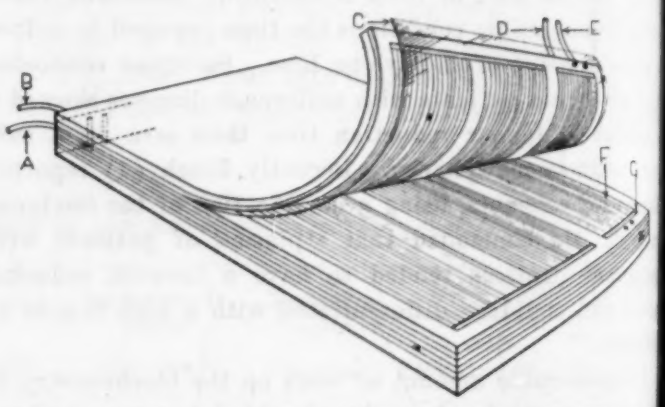

FIG. 1. Diagram of continuous dialyzer. The top rubber pad has been bent back to show the relative position of the Cellophane (C) and the fine grooves (F) in the bottom rubber pad (G). A, B, D, E are inlet and outlet tubes for blood and dialyzing solution.

After considerable preliminary work, 5 bilaterally nephrectomized dogs were successfully dialyzed. Using heparin as an anticoagulant,[4] the blood was taken from a cannula in the femoral artery, passed through the dialyzer, and returned to the femoral vein. The dialyzing solution was prepared to contain the same electrolyte concentration as extracellular fluid—namely (in meq/liter), sodium, 142; potassium, 5; calcium, 5; magnesium, 3; and chloride, 113; bicarbonate, 31; lactate, 8; phosphate, 3—and sufficient dissolved carbon dioxide to keep

[1] Supported in part with funds made available by the Smith, Kline and French Laboratories, Philadelphia, Pennsylvania, and the Miles Laboratories, Elkhart, Indiana.

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[3] The authors are indebted to the Houck Machine Company, Barberton, Ohio, for cooperating in the machining of a specially designed mold, and to A. E. Sidnell and the personnel of the Seiberling Latex Products Company, Akron, Ohio, for molding the rubber pads.

[4] In order to retard blood clotting further, the rubber pads are coated with a nonwetting film of silicone resin, for which we are indebted to W. R. Collings and W. Pedersen, of the Dow Corning Corporation, Midland, Michigan.

e pH at 7.3–7.4. The results have been summarized in able 1.

In all cases the blood urea nitrogen was appreciably creased, and significant amounts of urea were removed. those animals in which the acid-base balance was disrbed, there was a tendency for return to normal. For ample, dog No. 20 had repeatedly vomited, and before alysis the plasma chloride was 86 meq/liter and the O_2 content 92 volumes %, indicating a moderately vere metabolic alkalosis. Following dialysis the values re restored to 97 meq/liter and 68 volumes %, respecvely. The animals showed no apparent harmful effects om the procedure, and in several cases clinical improvent was noted. However, we have not yet been successl in keeping the animals alive for a significantly longer riod than the controls.

The apparatus is also useful for many problems in boratory dialysis. For example, during the preparaon of renin (*8*) from hog kidneys, a solution of the acve principle (volume, 8 liters from 3.5-kg kidneys) is alyzed for 3 days in 3″ Visking Cellophane tubes in der to remove trichloroacetic acid and other salts.

TABLE 1

REMOVAL OF UREA FROM NEPHRECTOMIZED DOGS BY EXTERNAL DIALYSIS

Dog No.	Hrs after nephrectomy	Wt. of dog (kg)	No. of kidney units	Blood urea nitrogen (mg/100 ml)		Hrs of dialysis	Urea removed (gm)
				Before dialysis	After dialysis		
14	72	10.5	6	152	54	7.0	18.8
16	60	8.6	4	216	57	5.6	23.1
17	72	8.0	4	...	88	4.5	21.8
19	84	25.0	8	184	81	5.6	38.0
20	60	16.4	8	179	46	7.6	31.7
20	96	15.0	8	130	80	2.5	...

ing 6 units of the present dialyzer, the same efficiency dialysis was accomplished in 20 hrs. If more units d been used, the time would have been proportionately orter. The dialyzing water was cooled by passing rough copper coils immersed in an ice bath, and the alysis was carried out at 2° C without the necessity of rking in a large, cold room.

In summary, a continuous dialyzer has been constructed ich should find applications both as a laboratory tool d as an "Artificial Kidney." Advantages include a ge dialyzing surface relative to the volume of contained lutions, efficient dialysis because the fluids on both es of the Cellophane are in a thin film and rapidly ving countercurrent to one another, and easy sterilizan of the completely assembled unit. The apparatus ows promise for the treatment of acute renal insufiency.

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Sensitivity of the Ninhydrin Reaction in Paper Partition Chromatography[1]

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The method of Consden, Gordon, and Martin (*1*) for the qualitative separation of amino acids by partition chromatography on filter paper is being used by the authors in studies of the amino acids in the blood and tissues of insects. This technique is particularly adaptable to physiological investigations with insects because it requires only micro quantities of the substances to be analyzed. Most of the free amino acids present in 25 microliters of insect blood can be qualitatively identified by this method.

In order to estimate quantitatively the free amino acids present in insect blood and tissues, and in order to determine the quantities of blood or tissue extracts necessary to identify qualitatively all of the amino acids present, the sensitivity of several amino compounds to the ninhydrin reaction was determined. This was done after pure amino compounds had been run in the separation chambers under the same conditions as the biological fluids being analyzed. Measured quantities of freshly made, pure solutions were placed on the filter paper, run 28 hrs in water-saturated phenol in one dimension, dried, run for 60 hrs in the second dimension in a water-saturated 1:1 mixture of γ-collidine and 2,4-lutidine, and again dried. The temperature was held between 23° and 26° C during the runs. The paper was then sprayed with a 0.1% solution of ninhydrin in normal butanol and heated in an oven for 5 min between

[1] Aided by a grant from the Lalor Foundation, Wilmington, Delaware.

80° and 100° C. If the temperature is below 70° C when the paper is placed in the oven, the sensitivity of the ninhydrin reaction may be decreased due to yellowing of the paper. The positions of the colored spots developed by the reaction of ninhydrin with the amino compounds on the paper (chromatogram) were revealed by light transmitted through the paper placed over an X-ray illuminator. By using transmitted rather than reflected light, the colored areas on the paper can be located much more readily, and a greater sensitivity can be obtained. In fact, spots which are not visible by reflected light can be readily located by transmitted light.

TABLE 1

Compound	Minimum quantity (μg)	Color of spot	R_f values: Phenol 28 hrs	R_f values: Collidine-lutidine 60 hrs
Alanine	0.2	Purple	0.63	0.41
β-Alanine	0.2	Blue	0.71	0.33
Alanylglycine	3	Pink purple	0.56	0.36
α-Amino-*n*-butyric acid	0.2	Purple	0.77	0.46
ε-Amino-*n*-caproic acid	0.5	"	0.91	0.34
Arginine monohydrochloride	4	Blue purple	0.66	0.14
Asparagine	1	Brown yellow	0.42	0.29
Aspartic acid	0.4	Blue	0.19	0.24
Citrulline	0.5	Purple	0.67	0.31
Cysteic acid	8	Blue	0.10	0.43
Glucosamine monohydrochloride	4	Purple brown	0.52	0.65
Glutamic acid	0.1	Purple	0.32	0.26
Glutamine	2	"	0.62	0.32
Glutathione	10	Blue purple	0.10	0.16
Glycine	0.1	Pink purple	0.42	0.33
Histamine dihydrochloride	12	Yellow brown	0.92	0.46
Histidine monohydrochloride	25	Brown	0.77	0.34
Homocystine	4	Purple	0.38	0.28
Hydroxyproline	1	Brown yellow	0.72	0.42
Isoleucine	0.5	Purple	0.88	0.62
Leucine	0.5	"	0.88	0.65
Lysine monohydrochloride	3	"	0.56	0.14
Methionine	1	"	0.85	0.61
Methionine sulfone	5	Brown purple	0.66	0.51
Methionine sulfoxide	1	Purple	0.84	0.34
Nor-leucine	0.4	"	0.89	0.69
Nor-valine	0.5	"	0.84	0.56
Ornithine monohydrochloride	3	"	0.42	0.13
Phenylalanine	5	Grey brown	0.90	0.67
Proline	1	Yellow	0.90	0.41
Serine	0.3	Brown red	0.37	0.37
Taurine	1	Purple	0.39	0.50
Threonine	2	Pink purple	0.53	0.43
Tryptophane	2	Yellow brown	0.79	0.66
Tyrosine	3	Brown	0.63	0.74
Valine	0.2	Purple	0.82	0.53

Table 1 lists the minimum quantities of several amino compounds which give a visible color with ninhydrin on a two-dimensional chromatogram when viewed by transmitted light.

The R_f value (rate of flow) is the ratio of the distance a compound moves along the paper to the total distance the solvent moves. These values therefore indicate the position a compound will occupy on the paper. They have not been found to be very consistent between different chromatograms, but are useful for comparing the relative positions of compounds on a single chromatogram.

All of these compounds were tested for sensitivity to ninhydrin on filter paper without being run in the solvents. Several were found to be more sensitive than was apparent from the chromatograms, thus indicating a certain amount of decomposition by the solvents. Cystine is completely decomposed when run in the second solvent mixture and must be oxidized to stable cysteic acid in order to give the ninhydrin test (*2*). A decrease in sensitivity to ninhydrin is most apparent with histidine, arginine, phenylalanine, and histamine.

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A Simple Method of Measuring the Surface Area of Small Objects of Irregular Shape[1]

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In the course of experiments with transplantable tumors it was found necessary to measure their surface area. Since the tumors were not symmetrical, no simple formula could be applied, and thus it was necessary to devise a method of measuring small, irregularly shaped objects. The method chosen depended upon determining quantitatively the amount of sodium chloride deposited on the surface of the object after immersion in a salt solution. The amount of sodium chloride thus deposited was then measured by dipping the object in a solution of silver nitrate and finding the amount of the silver salt which combined with the sodium chloride to form a silver chloride precipitate. To establish the reliability of the method, it had to be shown that objects of different sizes and shapes would yield sodium chloride measurements directly proportional to their surface area. If this were found to be true, the method would presumably be suitable for measuring the surface of irregularly shaped objects as well.

[1] This investigation was aided by a grant from The Donner Foundation, Inc., Cancer Research Division.

Spheres and cylinders of various sizes were selected as test objects because their surface areas may readily be calculated. The test spheres were ball bearings, 0.63–1.90 cm in diameter; the cylinders were made of wood dowel and were 1.30–1.87 cm in diameter and 0.83–1.56 cm in height. The surface areas were calculated from micrometer measurements of these objects, by appropriate formulas. Each object was then suspended on a thin wire to facilitate manipulation. In order to equalize the wetting properties of different materials, the spheres and cylinders were first coated by dipping them 5 times in 2% solution of agar at 70° C and permitting them to dry at room temperature in the intervals between dips. The sphere or cylinder was then immersed in 0.9% sodium chloride solution, slowly removed, and dipped in 25-cc sample of 0.15% silver nitrate solution. Immersion in the two different solutions was done 5 times, using the same sample of silver nitrate. The entire procedure was repeated twice, using two fresh aliquots of silver nitrate, so that for each test three determinations were made.

The amount of silver nitrate remaining in the solution was then determined by the method of Whitehorn (*1*).

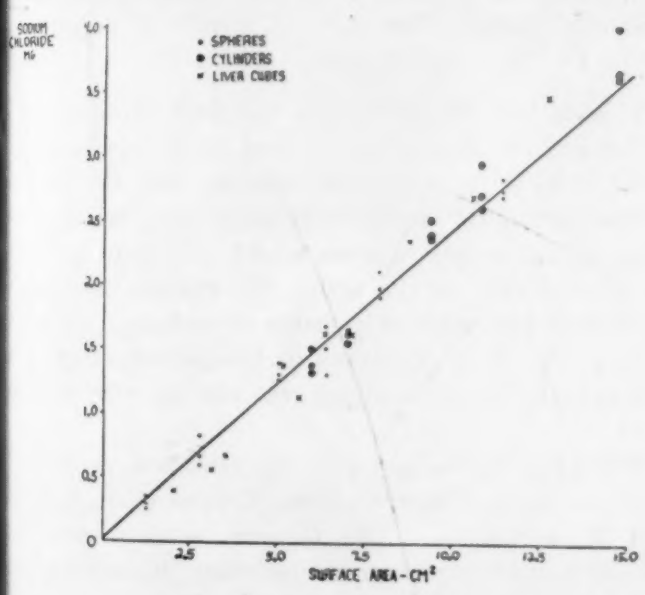

FIG. 1. Graph showing the rectilinear relationship of surface area to the quantity of sodium chloride coating the surface, using objects of different size and shape.

Five cc of concentrated nitric acid and 0.6 gm of ferric ammonium sulfate were added to the silver solution, and the mixture was titrated with 0.15% ammonium thiocyanate. The relative amount of silver nitrate reacting with the sodium chloride was equal to the difference between the amount of thiocyanate used to titrate a control sample of silver nitrate and that amount required to titrate the sample used in an experiment. This value was then multiplied by the calculated factor of 1.16 to determine the milligrams of sodium chloride which had reacted with the silver. The final values obtained for the three samples used for each test object were then averaged.

Measurements of this nature were performed on all spheres and cylinders on three separate occasions, and the results were graphed (Fig. 1). The ratio, k, of square centimeters of surface area to milligrams of sodium chloride was calculated for the spheres, using the expression $\frac{\Sigma (XY)}{\Sigma Y^2}$, where $X = cm^2$ of surface area, and $Y = mg$ of sodium chloride; the k value obtained was 4.06, with a standard deviation of ± 0.517. The k for the cylinders was 3.93, with a standard deviation of ± 0.804, a value which did not differ significantly from that obtained for the spheres, as the difference in ratios was only 1.18 times the standard error of the difference. Therefore, the values for both spheres and cylinders

TABLE 1

COMPARISON OF CALCULATED AND EXPERIMENTALLY MEASURED SURFACE AREAS (cm^2)*

Spheres		Cylinders	
Calculated	Measured	Calculated	Measured
1.26	1.04, 1.41, 1.13	6.00	5.61, 5.43, 6.13
2.85	2.74, 3.40, 2.45	7.03	6.32, 6.61, 6.55
5.10	5.66, 5.28, 5.14	9.39	9.77, 9.61, 10.24
6.38	6.14, 6.80, 5.28	10.77	11.04, 10.61, 12.03
7.93	8.60, 8.02, 7.78	14.64	14.95, 14.71, 16.36
11.41	10.98, 11.16, 11.55		

* The standard deviation of the differences between measured and calculated surface areas was ± 0.44 for the spheres, ± 0.63 for the cylinders, and ± 0.53 for the pooled data.

were pooled, the new k becoming 3.99, with a standard deviation of ± 0.34 cm^2. This new k could now be used to calculate the equation and slope of the line (Fig. 1). The equation was $X = 3.99\ Y$, where X is the surface area (cm^2) and Y is the milligrams of sodium chloride as determined by this method.

By the use of this equation it was possible to compare the known surface area of the objects used with the surface area found experimentally (Table 1). The average deviation for 33 observations was 0.39 cm^2.

In addition to the wooden and steel test objects, cubes were cut from fresh liver, as the method was ultimately to be applied to tissue. The surface areas were calculated, the cubes then being coated with agar and tested by the previously described procedure. The values obtained for 10 cubes tended to approximate the calculated line (Fig. 1); the necessarily less accurate measurements used for the calculation of surface area doubtlessly contributed to deviations. The k was 3.89, with a standard deviation of ± 0.84; this value was not significantly different from the pooled k calculated above, as the difference in ks was only 0.67 times the standard error of the difference.

Since it has been shown by these experiments that the reacting sodium chloride per unit surface area does not differ significantly when objects of different regular shapes are used, it seems reasonable to conclude that the method is applicable to objects of irregular shape and that the calculated curve based on sphere and cylinder values may be used in determining the surface area of irregularly-shaped objects.

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Book Reviews

Essentials of pharmacology. Frances K. Oldham, F. E. Kelsey, and E. M. K. Geiling. Philadelphia–London–Montreal: J. B. Lippincott, 1947. Pp xiv + 440. $5.00.

This comparatively short text is written primarily for students of medicine and allied professions. Its scope is almost entirely that of drugs presently in therapeutic use, and it follows closely the recent changes in the U. S. and British Pharmacopeias and New and Non-official Remedies; in addition, it includes information on many drugs not yet in general use. The book begins with a short, well-chosen history of the subject and, aside from a brief section on general principles, is divided into two sections. The first describes "Functional Drugs," those used primarily to modify physiological function, and the second, "Chemotherapeutic Agents," those directed against invasion by parasites and in which all the actions on the host are secondary. Considering its small size, the volume is surprisingly comprehensive, but it omits most physiological "tool" drugs such as nicotine, strychnine, muscarine, etc. There are only a few substances described that are important because of their toxicity, unless they are also commonly employed in therapy. The references are well chosen but few in number, and the book would not serve as a sufficient reference source for advanced students. The subject matter is so condensed that the student may have difficulty in following it. This is especially true of the sections dealing with autonomic drugs and with water and electrolyte metabolism. On the other hand, the proportion of the text devoted to chemotherapy and to the endocrines is somewhat larger than that customarily found and is consistent with the recent extensive developments in these fields.

The statement that "scopolamine is the most active of the belladonna alkaloids partly because of its greater solubility which permits more rapid passage of the site of action" (p. 48) suggests that solubility in water is a limiting factor in the action of these drugs, whereas the solubility of either atropine or its salts in body fluids is probably thousands of times greater than the maximum dose employed. Again (p. 76), the statement that chloral hydrate "acts rapidly because of its ready solubility" is opposed to the more general view that this drug is unusual in being a central nervous system depressant in spite of, and not because of, its high water solubility. The statement that an "oliguria may arise because of the lack of salt to aid in the excretion of water" (p. 182) is at variance with generally accepted ideas of water metabolism, although the reverse may be true. There is considerable evidence that the xanthines act on the renal tubules rather than on the glomeruli, as stated (p. 184). There are several errors in the labeling of figures and formulas, and there are some errors in the structural formulas. Obviously, the formula for myanesin (p. 52) is incorrect, as is that for the barbiturate ring (p. 81). The labeling of the chart on autonomic drug (p. 126) is very confusing and in some parts erroneous.

At a time when many of the established textbooks of pharmacology are out of date this book fills a needed place, but it is too brief to cover the usual course for medical students. Perhaps its greatest value will be in reviewing the subject for examinations or in a short course for dentists, nurses, pharmacists, or others who are less seriously concerned with acquiring an adequate background for rational therapy.

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Frequency modulation. (Vol. 1.) Alfred N. Goldsmith *et al.* (Eds.) Princeton, N. J.: RCA Review, 1948. Pp. x + 515. (Illustrated.) $2.50.

This is the 7th volume in the RCA Technical Book Series and the first on the subject of Frequency Modulation. The switch to cloth binding and the improved format entitle this series to be taken more seriously than some of the earlier volumes would have indicated. Like its predecessors in the series, the volume comprises an exhaustive collection of reprints of technical papers contributed by RCA engineers to the periodical literature. Chronologically, the coverage extends from 1936 through 1947.

The editors have grouped the technical papers under four section headings: General, Transmission, Reception, and Miscellaneous. The General section opens with Crosby's 1937 paper on "Frequency Modulation Noise Characteristics"—the best-advertised feature of frequency modulation—and two papers on the band width and energy spectra of FM signals. The following sections on Transmission and Reception include an assortment of papers on topics ranging from basic research to technology. Each major section contains some papers reprinted in full and others briefly summarized. Good editorial judgment seems to have been exercised in this compression of the relevant material of more specialized or lesser interest.

The scientist faced with the problem of initiating himself into the mysteries of frequency modulation techniques will find this symposium of great value. It falls in the necessary-but-not-sufficient category, however, since the work of RCA engineers only is included. In spite of this institutional limitation of its coverage, RCA is to be applauded for making this impressive collection of material so conveniently available.

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